ANT CONTROL

PROFESSIONAL DEVELOPMENT
CONTINUING EDUCATION COURSE

Technical Learning College

Printing and Saving Instructions

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TLC
P.O. Box 3060
Chino Valley, AZ 86323

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Precept-Based Training CEU Course

This training course is made of “micro-content” or “precepts”– small chunks of information that can be easily digested. Using bite-size pieces of technical information is considered to be one of the most effective ways of teaching people new information because it helps the student to retain knowledge easier.

Micro-learning or precept-based training doesn’t rely on the student to process a large amount of information before breaking it down. Our method includes short modules with clearly defined learning goals for each section. This method allows a student to hone in on a particular skill, then demonstrate their knowledge in the final assessment.

Some States and many employers require the final exam to be proctored.

Do not solely depend on TLC’s Approval list for it may be outdated.

Most of our students prefer to do the assignment in Word and e-mail or fax the assignment back to us. We also teach this course in a conventional hands-on class. Call us and schedule a class today.

Responsibility

This course contains portions of EPA’s WPS federal rule requirements. Please be aware that each state implements pesticide regulations that may be more stringent than EPA’s or OSHA’s regulations. Check with your state environmental/pesticide agency for more information. You are solely responsible in ensuring that you abide with your jurisdiction or agency’s rules and regulations.

Technical Learning College's Scope and Function

Welcome to the Program,

Technical Learning College (TLC) offers affordable continuing education for today's working professionals who need to maintain licenses or certifications. TLC holds several different governmental agency approvals for granting of continuing education credit.

TLC's delivery method of continuing education can include traditional types of classroom lectures and distance-based courses or independent study. TLC's distance-based or independent study courses are offered in a print - based distance educational format. We will beat any other training competitor's price for the same CEU material or classroom training.

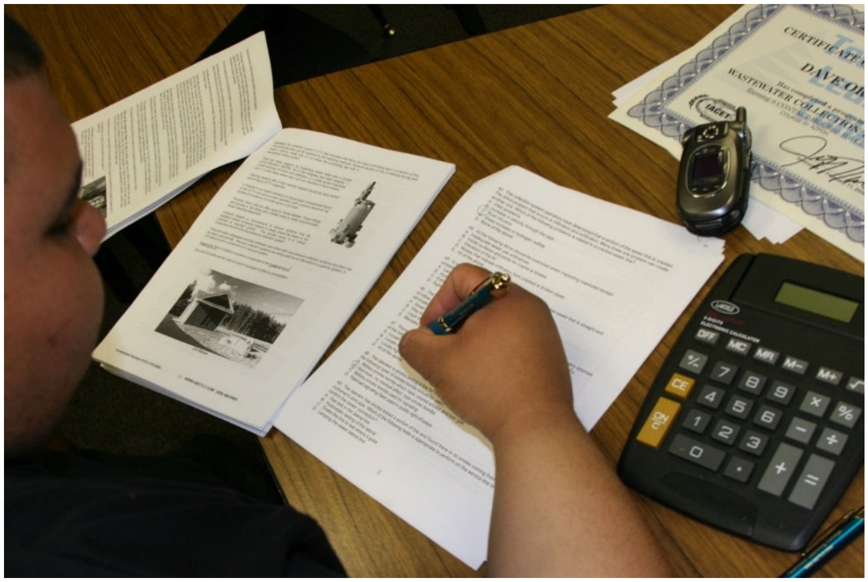
Our courses are designed to be flexible and for you to finish the material at your convenience. Students can receive course materials through the mail or electronically. The CEU course or e-manual will contain all your lessons, activities and instruction to obtain the assignments. All of TLC's CEU courses allow students to submit assignments using e-mail or fax, or by postal mail. (See the course description for more information.)

Students have direct contact with their instructor—primarily by e-mail or telephone. TLC's CEU courses may use such technologies as the World Wide Web, e-mail, CD-ROMs, videotapes and hard copies. (See the course description.) Make sure you have access to the necessary equipment before enrolling; i.e., printer, Microsoft Word and/or Adobe Acrobat Reader. Some courses may require proctored closed-book exams, depending upon your state or employer requirements.

Flexible Learning
At TLC, there are no scheduled online sessions or passwords you need contend with, nor are you required to participate in learning teams or groups designed for the "typical" younger campus - based student. You will work at your own pace, completing assignments in time frames that work best for you. TLC's method of flexible individualized instruction is designed to provide each student the guidance and support needed for successful course completion.

Course Structure
TLC's online courses combine the best of online delivery and traditional university textbooks. You can easily find the course syllabus, course content, assignments, and the post-exam (Assignment). This student-friendly course design allows you the most flexibility in choosing when and where you will study.

Classroom of One
TLC offers you the best of both worlds. You learn on your own terms, on your own time, but you are never on your own. Once enrolled, you will be assigned a personal Student Service Representative who works with you on an individualized basis throughout your program of study. Course specific faculty members (S.M.E.) are assigned at the beginning of each course providing the academic support you need to successfully complete each course. Please call or email us for assistance.



We welcome you to do the electronic version of the assignment and submit the answer key and registration to us by either fax or e-mail. If you need this assignment graded and a certificate of completion within a 48-hour turn around, prepare to pay an additional rush charge of $50.

Contact Numbers

Fax (928) 468-0675
Email Info@tlch2o.com
Telephone (866) 557-1746

CEU Course Description

Ant Control CEU Training Course

Ants live practically everywhere, but are most abundant in warm climates. There are about 10,000 kinds, or "*species*," of ants. Within each species there are usually many different types. Ants are social insects that live in colonies and are some of the most successful insects.

Fire ants are nuisance insects. They sting humans, their pets, and their livestock. They also cause electrical outages in air-conditioning units and other electrical devices. Mowing can be hazardous due to the mounds the ants build and the stings inflicted. Their aggressive nature makes them easy to identify. Killing fire ants without understanding the basic biology of the insect can be difficult. The red imported fire ant (RIFA), *Solenopsis invicta*, is the species of fire ant that is causing problems throughout the southeastern U.S. A native of South America, RIFA is similar to other ant species. At the center of every mound or colony is a queen or queens. If you want to kill the colony, you have to kill the queen.

Eradication of this pest is not possible, but we can learn to minimize their impact on our lives. Through the use of an education program, ant problems can be minimized.

Course Procedures for Registration and Support
All of Technical Learning College's (**TLC's**) correspondence courses have complete registration and support services offered. Delivery of services includes, e-mail, Web site, telephone, fax, and mail support. TLC will attempt immediate and prompt service. All students are tracked by a unique number which will be assigned to the student.

Instructions for Written Assignments
The Ant Control CEU training correspondence course uses a multiple choice style answer key.

You may write your answers or type out your own answer key. TLC would prefer that you utilize the answer key found on the TLC website under Assignments and e-mail the answer key to TLC, but it is not required.

Feedback Mechanism (examination procedures)
Each student will receive a feedback form as part of his or her study packet. You will be able to find this form in the front of the assignment.

Security and Integrity
All students are required to do their own work. Lesson sheets and final exams are not returned to the student to discourage sharing of answers. Any fraud or deceit and the student will forfeit all fees and the appropriate agency will be notified.

Grading Criteria
TLC offers the student either pass/fail or a standard letter grading assignment. If TLC is not notified, only a pass/fail notice will be issued.

Required Texts
The course will not require any other materials. This course comes complete.

Pesticide Terms, Abbreviations, and Acronyms
TLC provides a glossary in the rear of this manual that defines in non-technical language commonly used environmental terms appearing in publications and materials. It also explains abbreviations and acronyms used throughout the EPA and other governmental agencies.

Recordkeeping and Reporting Practices
TLC keeps all student records for a minimum of five years. It is the student's responsibility to give the completion certificate to the appropriate agencies.

ADA Compliance
TLC will make reasonable accommodations for persons with documented disabilities. Students should notify TLC and their instructors of any special needs. Course content may vary from this outline to meet the needs of this particular group.

Note to Students: Keep a copy of everything that you submit. If your work is lost, you can submit your copy for grading. If you do not receive your graded assignment or quiz results within two or three weeks after submitting it, please contact your instructor. We expect every student to produce his/her original, independent work.

Any student whose work indicates a violation of the Academic Misconduct Policy (cheating, plagiarism) can expect penalties as specified in the Student Handbook, which is available through Student Services; contact them at (928) 468-0665.

A student who registers for a Distance Learning course is assigned a **"start date"** and an **"end date."** It is the student's responsibility to note due dates for assignments and to keep up with the course work.

If a student falls behind, she/he must contact the instructor and request an extension of her/his ***end date*** in order to complete the course. It is the prerogative of the instructor to decide whether to grant the request.

Students have 90 days from receipt of this manual to complete it in order to receive your Continuing Education Units (**CEUs**) or Professional Development Hours (**PDHs**). A score of 70% is necessary to pass this course.

If any assistance is needed, please e-mail all concerns or call us. If possible, e-mail the final test to info@tlch2o.com or fax (928)468-0675.

Course Objective: To provide training in ant identification, termite identification, control, and effective safe pesticide applications and treatment methods.

Educational Mission

The educational mission of TLC is:

To provide TLC students with comprehensive and ongoing training in the theory and skills needed for the pesticide application field,

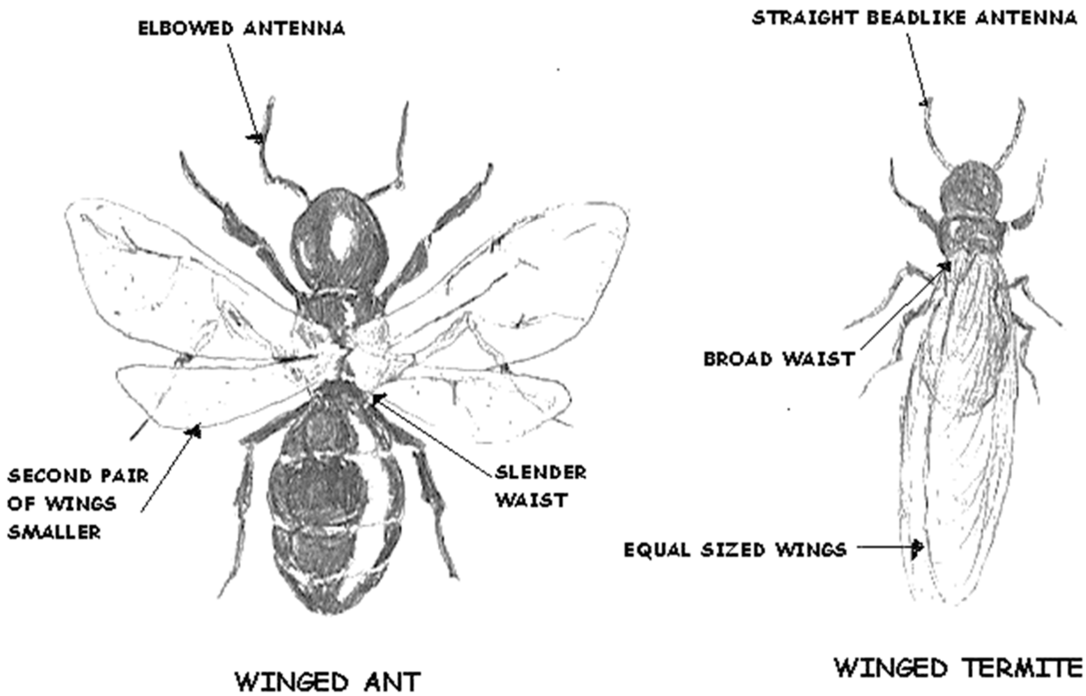
To provide TLC students with opportunities to apply and understand the theory and skills needed for pesticide application,

To provide opportunities for TLC students to learn and practice pesticide application skills with members of the community for the purpose of sharing diverse perspectives and experience,

To provide a forum in which students can exchange experiences and ideas related to pesticide application education,

To provide a forum for the collection and dissemination of current information related to pesticide application education, and to maintain an environment that nurtures academic and personal growth.

YELLOW CRAZY ANT



WINGED ANT AND WINGED TERMITE DIAGRAM

Why Are Termites Covered?

Because ant identification and treatment(s) are similar and are done in conjunction with termites, both ants and termites treatments are covered. Many times these treatments are essentially the same products, but many treatments are specifically for only one species and not for the other. Always read and follow the product label.

Important Information about this Manual

This manual has been prepared to educate pesticide applicators and operators in general safety awareness of dealing with the often-complex and various pesticide treatment devices, methods, and applications.

This manual will cover general laws, regulations, required procedures and accepted policies relating to the use of pesticides. It should be noted, however, that the regulation of pesticides and hazardous materials is an ongoing process and subject to change over time. For this reason, a list of resources is provided to assist in obtaining the most up-to-date information on various subjects.

This manual is not a guidance document for applicators or operators who are involved with pesticides. It is not designed to meet the requirements of the United States Environmental Protection Agency or your local State environmental protection agency or health department.

This course manual will provide general pesticide safety awareness and should not be used as a basis for pesticide treatment method/device guidance. This document is not a detailed pesticide or a source or remedy for poison control.

Technical Learning College or Technical Learning Consultants, Inc. makes no warranty, guarantee or representation as to the absolute correctness or appropriateness of the information in this manual and assumes no responsibility in connection with the implementation of this information.

It cannot be assumed that this manual contains all measures and concepts required for specific conditions or circumstances. This document should be used for educational purposes only and is not considered a legal document.

Pesticides are poisonous. Always read and carefully follow all precautions and safety recommendations given on the container label. Store all chemicals in the original labeled containers in a locked cabinet or shed, away from food or feeds, and out of the reach of children, unauthorized persons, pets, and livestock.

Confine chemicals to the property being treated. Avoid drift onto neighboring properties, especially gardens containing fruits and/or vegetables ready to be picked.

Dispose of empty containers carefully. Follow label instructions for disposal. Never reuse containers. Make sure empty containers are not accessible to children or animals. Never dispose of containers where they may contaminate water supplies or natural waterways. Do not pour down sink or toilet. Consult your county agricultural commissioner for correct ways of disposing of excess pesticides.

Never burn pesticide containers.

Individuals who are responsible for pesticide storage, mixing and application should obtain and comply with the most recent federal, state, and local regulations relevant to these sites and are urged to consult with the EPA and other appropriate federal, state and local agencies.

Please wear a respirator and PPE anytime you are working with product. Too many applicators have developed lung diseases and cancer from working with pesticides. I would say that most professional applicators will develop some pesticide related diseases and most of these are because the applicator did not wear proper PPE or have proper medical fit-testing or training.

Pesticide Poisoning

Insecticides cause the greatest number of pesticide poisonings in the United States. The most serious pesticide poisonings usually result from acute exposure to organophosphate and carbamate insecticides.

Seeking Medical Attention 1-800-222-1222

If you are having symptoms but are unsure if they are pesticide related, at least notify someone in case your symptoms become worse. Nevertheless, when symptoms appear after contact with pesticides, you should seek medical attention immediately. At this time, call the **National Poison Center at 1-800-222-1222** for guidance on the proper response to your symptoms. This number will direct your call to the nearest poison center, which is staffed on a 24-hour basis.

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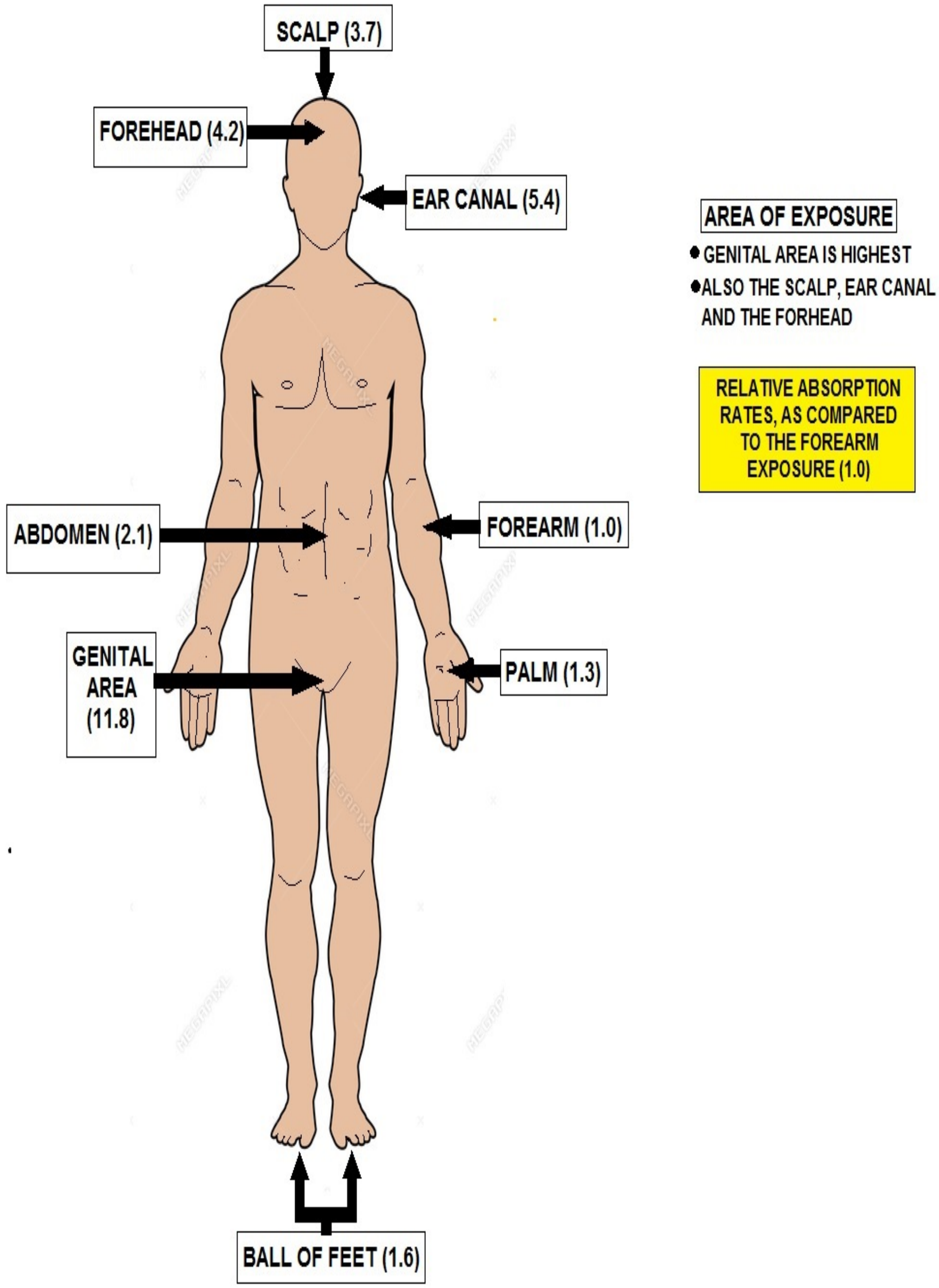


ABSORPTION RATES OF PESTICIDE EXPOSURE

Key Words

Adjuvant: Any substance added to pesticide which improves the activity of the active ingredient. *Examples*: Penetrates, spreader-stickers and wetting agents.

Adventive: Located outside habitat, though a reproductive population may not be established.

Alates: Winged forms of insects.

Beneficial insect: Any insect that has a life style that is advantageous to man. Insects that preserve the balance of nature by feeding on others, pollinators, and recyclers are examples of beneficial insects.

Cephalothorax: Head (ceph) and chest (thorax) area.

Cerci: Paired appendages on the end of the abdomen of many insects which are used for sensing, defense or mating.

Chewing (mouth parts): Any mouth part that literally bites to feed; other mouth part types are sucking and rasping.

Clavus: The enlarged terminal antennal segments that form a club.

Collophore: A tube-like structure on the underside of the first abdominal segment (folds under the body) of Collembola (e.g. springtails) which is used as a spring action for leaping.

Broad Spectrum Application: General purpose pesticides which can be used against a large number of pests on a wide range of crops.

Broadcast Application: The application of a pesticide or other material over the entire field or area.

Calibrate: To determine the amount of pesticide that will be applied to the target area.

Colonizing: An ant species which is successful at creating nests in new areas. While some exotic ants are successful colonizers, many colonizing species are not exotic -- and many exotics are not colonizers.

Compound eyes: The large multi-faceted eyes of insects.

Dealates: Winged forms that have shed their wings, like reproductive termites or ants.

Detritivore: Any organism that eats decaying organic matter.

Dimorphic: Having two distinct forms.

Dust: A finely ground, dry pesticide formulation usually containing a small amount of active ingredient and a large amount of inert carrier or diluent such as clay or talc.

Emulsifiable Concentrate: A pesticide formulation produced by dissolving the active ingredient and an emulsifying agent in a suitable solvent. When added to water, an emulsion (milky mixture) is produced.

Estivation (aestivation): A resting stage (quiescence) resulting from continued high temperature or xeric conditions; diapause; hibernation.

Frass: Solid larval insect excrement; plant fragments made by wood-boring insects, usually mixed with excrement.

Eradication: The complete elimination of either weeds, insects, disease organisms, or other pests from an area.

Fumigant: A chemical that forms vapors (gases) which are used to destroy weeds, plant pathogens, insects or other pests.

Genera: Plural of genus; A genus is a group of plants or animals with similar characteristics.

Insecticide: A pesticide that is used to kill, inhibit, repel or otherwise prevent damage by pests.

Introduced: Same as non-native.

Invasive: A species which is spreading its geographic range into niches occupied by other species. Documentation of an invasive species requires an ecological study to demonstrate the displacement of other ants.

Larval stage (larva, larvae): An immature insect, sometimes used to include all immature stages, even eggs. Usually this term refers more specifically to the feeding stages of insects with complete metamorphosis like grubs, caterpillars, and maggots.

Microbial Pesticide: Bacteria, viruses, fungi and other microorganisms used to destroy or control pests.

Pedipalps: Second pair of appendages of the cephalothorax corresponding to the mandibles of insects.

Pseudergates: Caste found in the lower termites (Isoptera), comprised of individuals having regressed from nymphal stages by molts eliminating the wing buds, or being derived from larvae having undergone non-differentiating molts, serving as the principle elements of the worker caste, but remaining capable of developing into other castes by further molting.

Pupal stage (pupa): The stage in complete metamorphosis between larva and adult like the cocoon in moths.

Pesticide: A chemical or other agent used to kill or otherwise control pests.

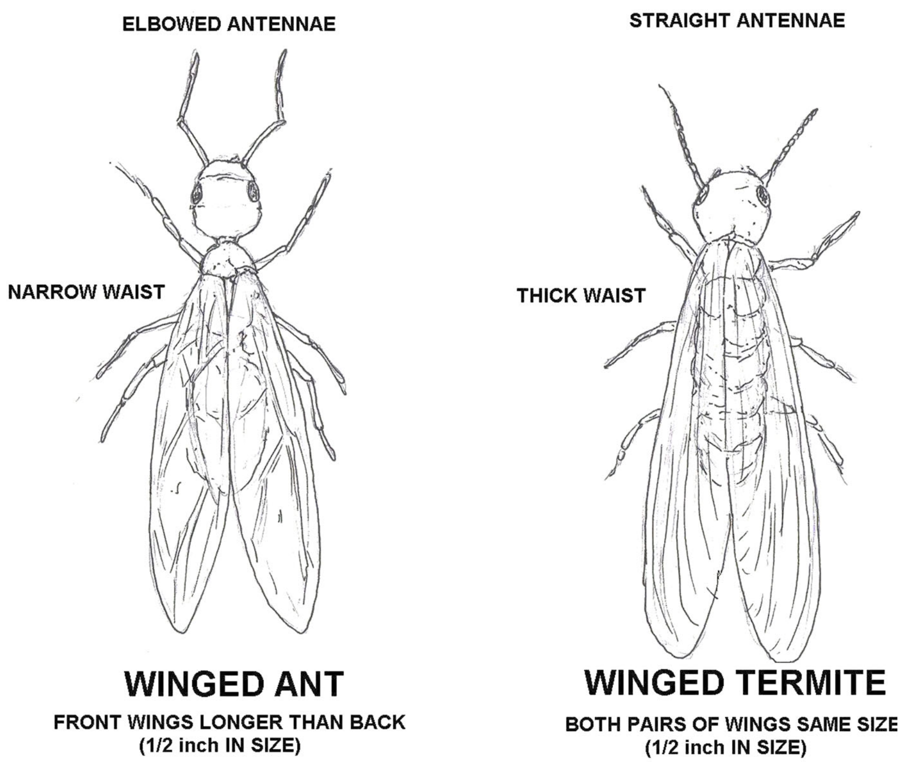
Protectant: A pesticide applied to a plant or animal prior to the appearance or occurrence of the pest in order to prevent infection or injury by the pest.

Repellant: A compound that keeps or drives away insects, rodents, birds or other pests from plants, domestic animals, buildings or other treated areas.

Topic 1 - One Node Ant Identification and Control Section

Topic 1 - Section Focus: You will learn the fundamentals of ants including identification and control techniques. At the end of this section, you will be able to understand and describe one-node ant control and elimination techniques. There is a post quiz at the end of this section to review your comprehension and a final examination in the Assignment for your contact hours.

As a termite pest controller, many of your calls for termites are not termites but ants and vice versa. Ants and termites are enemies are occasionally found together. We will master ant identification and control methods.



Ant Introduction

Ants form colonies that range in size from a few dozen predatory individuals living in small natural cavities to highly organized colonies that may occupy large territories and consist of millions of individuals.

All ants like termites live in colonies, which consist of an egg-laying female (queen), short-lived males, and workers (sterile females). Larger colonies consist of various castes of sterile, wingless females, most of which are workers (ergates), as well as soldiers (dinergates) and other specialized groups. Nearly all ant colonies also have some fertile males called "drones" (aner) and one or more fertile females called "queens" (gynes).

The colonies are described as superorganisms because the ants appear to operate as a unified entity, collectively working together to support the colony just as termites.

Ants have colonized almost every landmass on Earth. The only places lacking indigenous ants are Antarctica and a few remote or inhospitable islands.

Ants thrive in most ecosystems and may form 15–25% of the terrestrial animal biomass. Their success in so many environments has been attributed to their social organization and their ability to modify habitats, tap resources, and defend themselves.

Ant colonies have division of labor, communication between individuals, and an ability to solve complex problems. These parallels with human societies have long been an inspiration and subject of study.

Some species are valued in their role as biological pest control agents. Their ability to exploit resources may bring ants into conflict with humans, however, as they can damage crops, invade buildings and for our study- destroy wood. Some species, such as the red imported fire ant (*Solenopsis invicta*), are regarded as invasive species, establishing themselves in areas where they have been introduced accidentally.

Trail Pheromone

The ants you see foraging in gardens or kitchens are workers. Workers that find food communicate with other workers by depositing a chemical message on the substrate as they crawl back to the nest.

Although we cannot smell it, this "*trail pheromone*" sticks to the substrate for long periods of time and helps other ants find the food at the end of the trail. In the spring, ants develop wings, fly to new locations, and invade homes to forage for food or to establish a new nest.

Ants are a major annoyance to homeowners and are difficult to control. As with cockroaches, you should not underestimate the importance of good sanitation to eliminate food sources, although good sanitation may not control an ant infestation by itself.

Ants are beneficial organisms in the balance of nature. In nature, ants greatly reduce the amount of dead and decaying plant and animal organic matter. They also aerate the soil with their nests. Many ant species have a fondness for honeydew that aphids produce from feeding on plants. Large numbers of ants crawling on a plant may be a sign of serious aphid infestation.

Ant Infestations

Ant infestations are not easy to control and different strategies should be used depending on nest location and food preferences of the ants.

Ants can be controlled with a combination of good sanitation, removing pheromone trails, caulking entry points, and eliminating active nests. Insecticide sprays and baits can be used to kill foraging ants and destroy nests, but strategies designed to prevent further infestations should be used in conjunction with chemical treatment. We will go more into detail on these subjects later.

There are 455 different types of ants found in North America and around 8,000 worldwide that have been identified. They are black, brown or reddish-brown in color. Size varies from 1/16 of an inch long to 1 inch. The queens may from 1 to as long as 15 years! It is the carpenter ants that invade decaying areas of lumber in buildings hollowing them out and causing serious structural damage.

Stinging ants like the red imported fire ant (reddish color, 1/4 inch in length) and the southern fire ant (brownish-red with black of brown abdomen and head, 1/16 to 1/4 inch in length) inflict highly painful stings. They can be quite dangerous to babies and young children. All ant ants aside if you can tolerate some ants, they are fascinating to watch. They do aerate the soil and destroy some caterpillar pests.

Most ants eat a wide variety of foods, although some have specialized tastes. Fire ants feed on honeydew, sugars, proteins, oils, seeds, plants and insects. Pharaoh ants feed on sugars, proteins, oils and insects. Crazy ants like sugars, protein, and insects; carpenter ants prefer sugars and insects.

Hymenoptera Insect Order
Ants belong to the insect order Hymenoptera and are close relatives of bees and wasps. They are familiar insects that are easily recognized, especially in their common wingless adult forms, known as workers. However, winged forms of ants, which leave the nest in large numbers in warm weather to mate and establish new colonies, are often mistaken for winged termites, which also leave their nests to mate.

Differences Between Ants and Termites

Body shape: A termite has no "waist," instead, its body is more rectangular, without any narrowing in the center. In contrast, the carpenter ant has a very well-defined narrow, constricted waist.

Antennae: An insect's feelers can say a lot about the insect, too. A termite has straight, beaded antennae, meanwhile, a carpenter ant's antennae are bent or "elbowed."

Wings: Both insects are winged creatures and each has four wings. A termite has wings that are of equal size and shape and its wings are much longer than its body. A carpenter ant's back, hind wings are shorter than its front forewings and the wings do not look unusually long or disproportionate to its body.

Another thing with termites is that their wings are not as durable as ants. The wings of the termite fall off easily. The loose wings can often be seen near the opening of a termite nest and can be used to identify a termite infestation. (Shortly after their flights, both ants and termites lose their wings, so wings may not always be present.)

Color: Ant workers are reddish or dark-colored and are frequently seen in the open foraging for food. Termite workers, by comparison, are transparent, light or creamy white in color, and they avoid light. Termites are rarely noticed unless their nest is disturbed.

Characteristics	**Ants**	**Termites**
Active Reproductives	Queen(s)	Queen and Kings
Antennae	Bent or "elbowed	Straight, beaded
Wings	Hind wings are shorter than its front forewings	Equal size and shape
Parthenogenesis	All Species	Never
Larval Stage	Yes	No
Eye Sight	Most Species	Workers are blind
Build Earthen "Ant Nest"	Rarely	Most Species
Carnivorous	Most Species	Very few species
Grow Fungus "Gardens"	Very few Species	Most Species

Key Words

Invasive: A species which is spreading its geographic range into niches occupied by other species. Documentation of an invasive species requires an ecological study to demonstrate the displacement of other ants.

Larval stage (larva, larvae): An immature insect, sometimes used to include all immature stages, even eggs. Usually this term refers more specifically to the feeding stages of insects with complete metamorphosis like grubs, caterpillars, and maggots.

Microbial Pesticide: Bacteria, viruses, fungi and other microorganisms used to destroy or control pests.

Pedipalps: Second pair of appendages of the cephalothorax corresponding to the mandibles of insects.

Pseudergates: Caste found in the lower termites (Isoptera), comprised of individuals having regressed from nymphal stages by molts eliminating the wing buds, or being derived from larvae having undergone non-differentiating molts, serving as the principle elements of the worker caste, but remaining capable of developing into other castes by further molting.

Pupal stage (pupa): The stage in complete metamorphosis between larva and adult like the cocoon in moths.

Pesticide: A chemical or other agent used to kill or otherwise control pests.

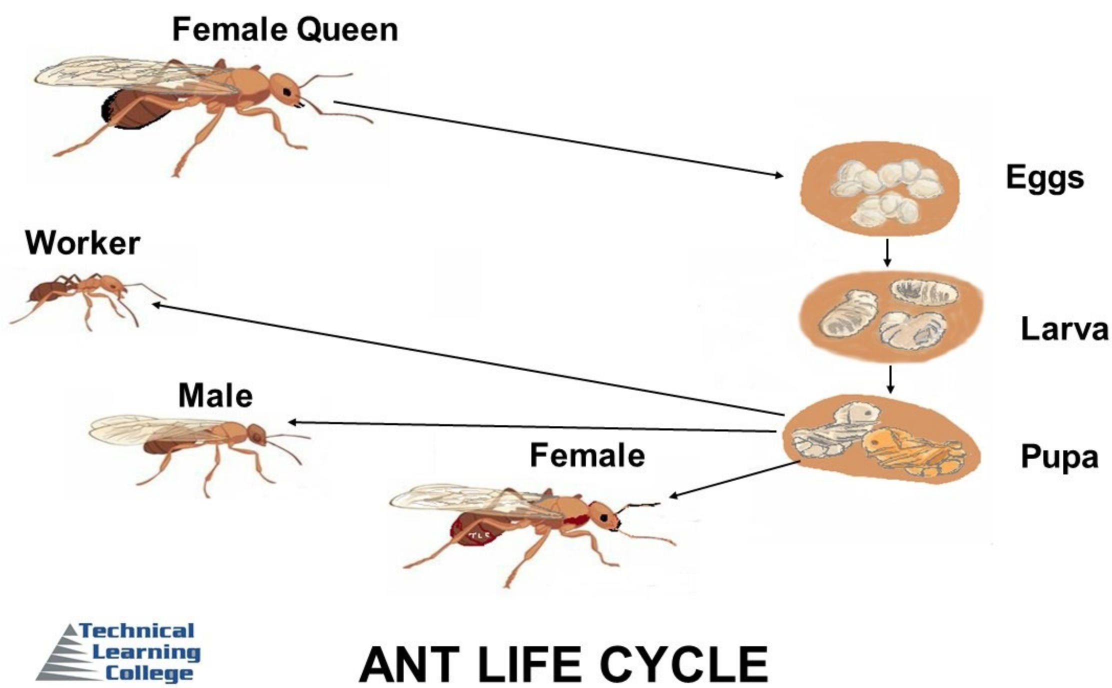
Protectant: A pesticide applied to a plant or animal prior to the appearance or occurrence of the pest in order to prevent infection or injury by the pest.

Metamorphosis

In order to properly identify the pest, you will need to identify the insect in all stages of life. Ants undergo complete metamorphosis, passing through egg, larval, pupal, and adult stages. Larvae are immobile and wormlike and do not resemble adults.

Ants, like many other hymenopterans, are social insects with duties divided among different types, or castes, of adult individuals. Queens conduct the reproductive functions of a colony and are larger than other ants; they lay eggs and sometimes participate in the feeding and grooming of larvae.

Female workers, who are sterile, gather food, feed and care for the larvae, build tunnels, and defend the colony; these workers make up the bulk of the colony. Males do not participate in colony activities; their sole purpose is to mate with the queens. Few in number, males are fed and cared for by workers.



Morphology

Definition: Morphology is the branch of biology that deals with the form of living organisms, and with relationships between their structures.

Ants are distinct in their morphology from other insects in having elbowed antennae, metapleural glands, and a strong constriction of their second abdominal segment into a node-like petiole. The head, mesosoma, and metasoma are the three distinct body segments. The petiole forms a narrow waist between their mesosoma (thorax plus the first abdominal segment, which is fused to it) and gaster (abdomen less the abdominal segments in the petiole). The petiole may be formed by one or two nodes (the second alone, or the second and third abdominal segments).

Like other insects, ants have an exoskeleton, an external covering that provides a protective casing around the body and a point of attachment for muscles, in contrast to the internal skeletons of humans and other vertebrates. Insects do not have lungs; oxygen and other gases, such as carbon dioxide, pass through their exoskeleton via tiny valves called spiracles. Insects also lack closed blood vessels; instead, they have a long, thin, perforated tube along the top of the body (called the "dorsal aorta") that functions like a heart, and pumps haemolymph toward the head, thus driving the circulation of the internal fluids. The nervous system consists of a ventral nerve cord that runs the length of the body, with several ganglia and branches along the way reaching into the extremities of the appendages.

Head

An ant's head contains many sensory organs. Like most insects, ants have compound eyes made from numerous tiny lenses attached together. Ant eyes are good for acute movement detection, but do not offer a high resolution image. They also have three small ocelli (simple eyes) on the top of the head that detect light levels and polarization.

Compared to vertebrates, most ants have poor-to-mediocre eyesight and a few subterranean species are completely blind. However, some ants, such as Australia's bulldog ant, have excellent vision and are capable of discriminating the distance and size of objects moving nearly a yard away.

Two antennae ("feelers") are attached to the head; these organs detect chemicals, air currents, and vibrations; they also are used to transmit and receive signals through touch. The head has two strong jaws, the mandibles, used to carry food, manipulate objects, construct nests, and for defense. In some species, a small pocket (infrabuccal chamber) inside the mouth stores food, so it may be passed to other ants or their larvae.

Mesosoma

Both the legs and wings of the ant are attached to the mesosoma ("thorax"). The legs terminate in a hooked claw which allows them to hook on and climb surfaces. Only reproductive ants, queens, and males, have wings. Queens shed their wings after the nuptial flight, leaving visible stubs, a distinguishing feature of queens. In a few species, wingless queens (ergatoids) and males occur.

Metasoma

The metasoma (the "abdomen") of the ant contains important internal organs, including those of the reproductive, respiratory (tracheae), and excretory systems. Workers of many species have their egg-laying structures modified into stingers that are used for subduing prey and defending their nests.

Polymorphism

Definition: Polymorphism in biology and zoology is the occurrence of two or more clearly different morphs or forms, also referred to as alternative phenotypes, in the population of a species. In order to be classified as such, morphs must occupy the same habitat at the same time and belong to a panmictic population (one with random mating).

In the colonies of a few ant species, there are physical castes—workers in distinct size-classes, called minor, median, and major ergates. Often, the larger ants have disproportionately larger heads, and correspondingly stronger mandibles. These are known as macrergates while smaller workers are known as micrergates. Although formally known as dinergates, such individuals are sometimes called "soldier" ants because their stronger mandibles make them more effective in fighting, although they still are workers and their "duties" typically do not vary greatly from the minor or median workers. In a few species, the median workers are absent, creating a sharp divide between the minors and majors. Weaver ants, for example, have a distinct bimodal size distribution. Some other species show continuous variation in the size of workers.

Carebara

Carebara is a genus of ants in the subfamily Myrmicinae. It is one of the largest myrmicine genera with more than 174 species distributed worldwide in the tropics and the Afrotropical region. Many of them are very tiny cryptic soil and leaf litter inhabitants. They nest in rotten wood to which the bark is still adherent in the Afrotropical region, or may be lestobiotic nesting near other ant species. Some species are known to exist parasitically within termite nests. Little is known about the biology of the species. However, they are notable for the vast difference in size between queens and workers.

The smallest and largest workers in Pheidologeton (a sub category in Carebara) diversus show nearly a 500-fold difference in their dry-weights. Workers cannot mate; however, because of the haplodiploid sex-determination system in ants, workers of a number of species can lay unfertilized eggs that become fully fertile, haploid males.

The role of workers may change with their age and in some species, such as honeypot ants, young workers are fed until their gasters are distended, and act as living food storage vessels. These food storage workers are called repletes. For instance, these replete workers develop in the North American honeypot ant Myrmecocystus mexicanus.

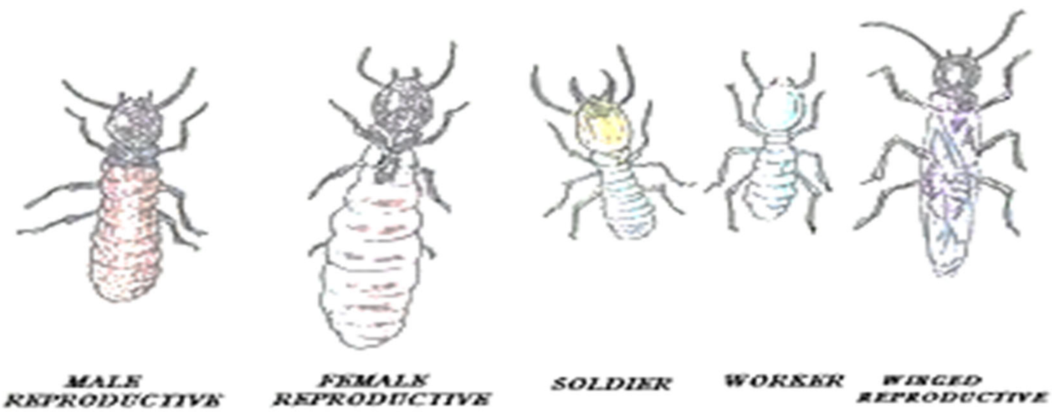
Usually the largest workers in the colony develop into repletes; and, if repletes are removed from the colony, other workers become repletes, demonstrating the flexibility of this particular polymorphism. This polymorphism in morphology and behavior of workers initially was thought to be determined by environmental factors such as nutrition and hormones that led to different developmental paths; however, genetic differences between worker castes have been noted in Acromyrmex sp.

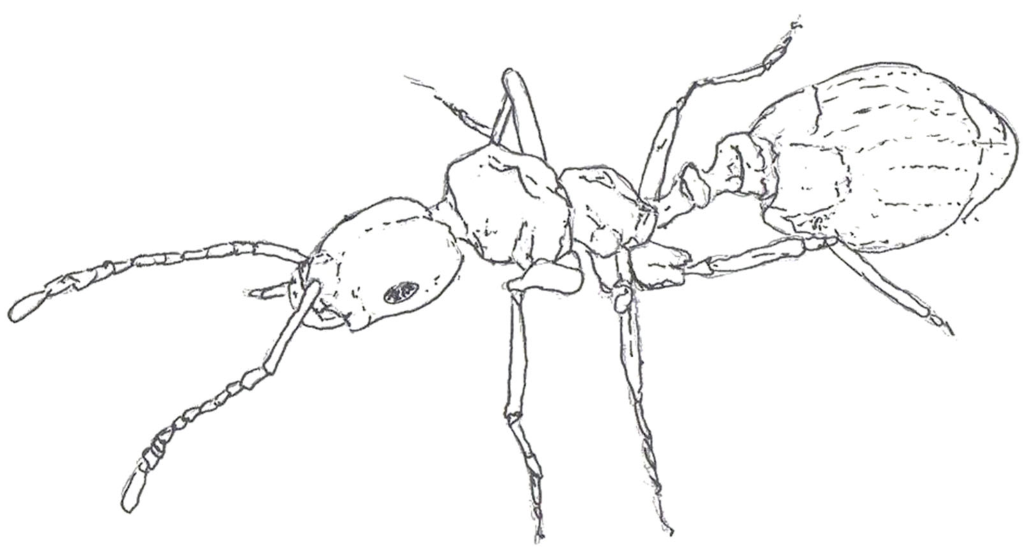
These polymorphisms are caused by relatively small genetic changes; differences in a single gene of Solenopsis invicta can decide whether the colony will have single or multiple queens. The Australian jack jumper ant (Myrmecia pilosula) has only a single pair of chromosomes (with the males having just one chromosome as they are haploid), the lowest number known for any animal, making it an interesting subject for studies in the genetics and developmental biology of social insects.

More About Termites Verses Ants Identification

Termites also develop wings and swarm during the spring and look similar to flying ants. Examine them closely to make sure that you have the correct pest! Ants are thin-waisted and have elbowed antennae. Termites have thicker waists and have antennae that resemble strings of tiny beads. You may need a magnifying glass to examine antennal features.

As a group, ants have a wide food range, feeding on sweet foods, greasy materials, starchy substances, wood, and all kinds of plant and animal materials. Part of the reason that ants become a nuisance in our homes is that they often like the same kinds of food that we do.





PHARAOH ANT

Ant Control Introduction

There are two categories of ants that will be encountered with an ant problem. The best control strategy depends on the type of infestation. Ants that live outside will travel inside the home to search for food. Some species may ultimately reside in houses, discussed later in this section. To prevent both of these scenarios, follow these general procedures:

First, properly identify the pest**.**

Second, cracks and crevices should be sealed to eliminate passages into the home. If you do not seal entry points, ants will probably find their way into your house at some later time. Place traps.

Third, scrub around entry points with a detergent (to remove the trail pheromone) and spray a residual insecticide around entry points. Bait treatments and insecticides can be used to control ants in the outside nest. To be effective, baits must be placed in areas where ants frequent, be eaten, and be taken back to the nest. There are several different kinds of baits available, and you may have to do a little trial-and-error to find the proper bait.

Because the ants must bring the insecticide back to the nest and to the queen for satisfactory control, this strategy may be incompatible with insecticide sprays, which may kill worker ants before they can get back to the nest with the bait. The successful use of a bait may take several weeks or more. Insecticide dilutions can be used outside to successfully drench ant nests. Be sure to follow label recommendations for correct procedures when applying the insecticide.

House Ants
There are some types of ants that actually establish a nest inside your home, instead of merely entering to forage for food and returning outdoors. Ants in this category may be present year round, although they will be more active in the warmer months. Ant species that may live in United States homes include *crazy ants, odorous house ants, pavement ants, pharaoh ants, thief ants, and carpenter ants*.

All of these ants may infest food products. Spraying a residual insecticide to control foraging workers may provide only short-term control. Even when over 99 percent of foraging workers are killed by insecticide sprays, the colony may rebuild to its original numbers. Location and total destruction of the nest is the most direct way to eliminate this ant infestation.

Ant baits, described above, can again be a useful tool in eradicating inside-the-home ant nests, although baits may not work as well with carpenter ants as with the other species mentioned. Again, workers must eat the bait, take it back to the nest, and feed it to the queen and larval ants. This type of control is incompatible with treatments that prevent workers from returning to the nest with the bait.

Conventional Pest Control Verses Integrated Pest Management

“Conventional” Pest Control

1. Chemical intensive
2. Emphasis on Killing pest directly
3. Largely reactive to pest outbreaks
4. Primary purpose of site visits is to apply more pesticide
5. General and overuse of pesticides
6. Less emphasis on prevention

Integrated Pest Management

1. Knowledge intensive
2. Emphasizes modification of conditions that favor pests
3. Systematic program of long-term pest control
4. Major purpose of most site visits is to inspect and monitor
5. Pesticide use is limited in terms of types, amounts and locations
6. Major emphasis on prevention of pest problems

IPM Control Program

An Integrated Pest Management (IPM) approach offers a greater chance for control of ants. An IPM approach incorporates all available control methods into a pest management program. IPM methods include identification, inspection, sanitation, exclusion, and chemical strategies. We will cover this in detail later in the course.

Collection Tip

One way to collect ants for identification is to place a dab of honey or sugar water in the center of an index card. Place the index card covered in ants into a plastic bag, and then place the bag in the freezer. The cold temperatures will slow the ants down or kill them. When they are immobilized, the ants can be easily tapped into a vial of alcohol and submitted for identification.

Types of Pesticide Spectrums

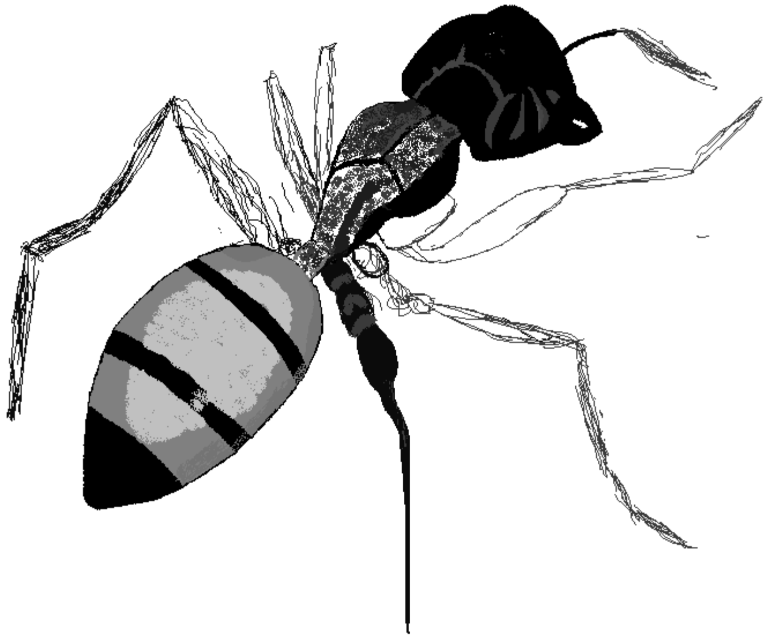
Broad-Spectrum

A pesticide that is effective against many pest. An example of a broad-spectrum pesticide is methyl bromide, which is designed to control pests ranging from small insects and pathogens to larger weeds and rodents. The pesticide can be injected into the ground to kill organisms in the soil that might harm the plant while it is growing. It can also be pumped into warehouses or barns to kill pests that could harm the plant during storage or transport for sale.

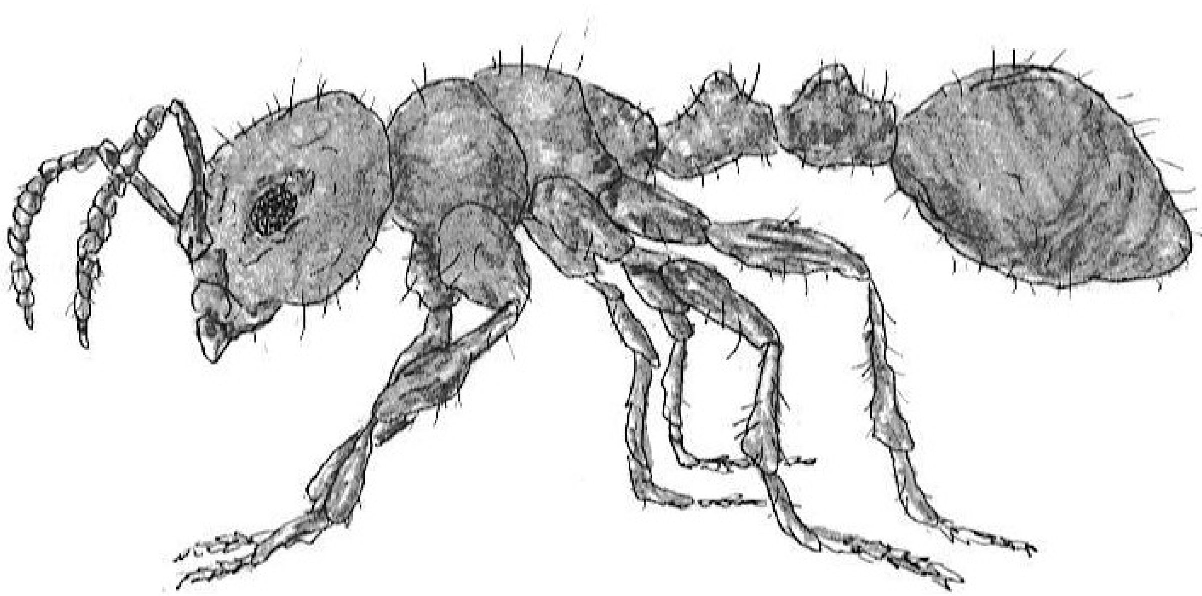
Narrow-Spectrum AKA Target-Spectrum

Developed to kill specific organism types. An example of a narrow-spectrum pesticide is chitin inhibitors, which are chemicals that interact with chitin, a component of the exoskeleton of insects. This pesticide inhibits the development of chitin and will eventually result in the death of the insect. The chitin inhibiting pesticide will only harm insects that have chitin in their exoskeletons and will not affect other insects.

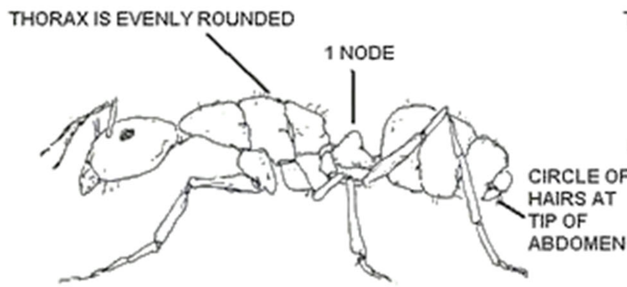
One Node Ant Identification Section



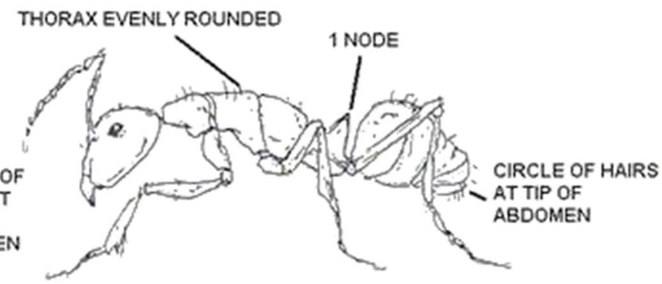
Top drawing, Carpenter Ant; below, Odorous House Ant or Piss Ant. One node verses two nodes.



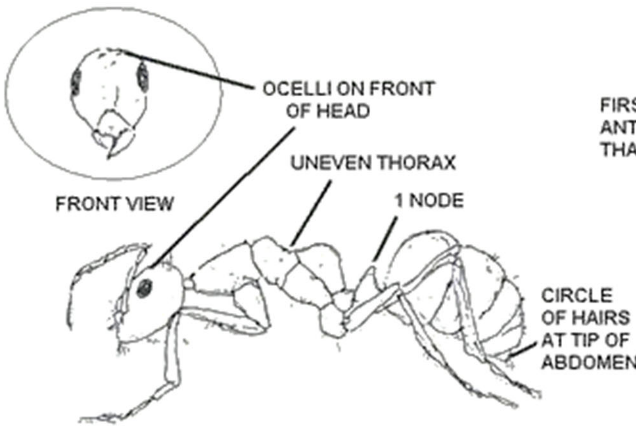
ANT IDENTIFICATION
(1-NODE ANTS)



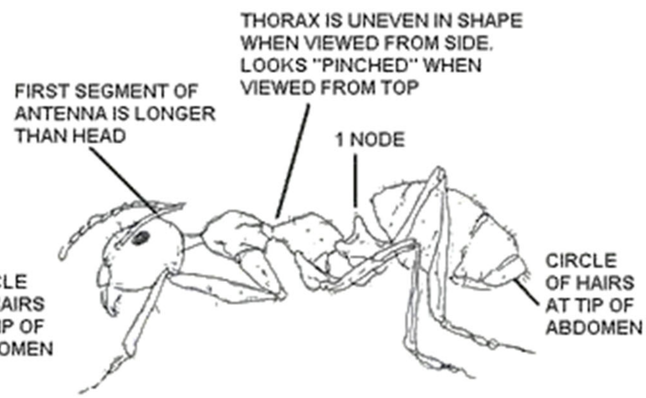
BLACK CARPENTER ANT
(Camponotus pennsylvanicus)



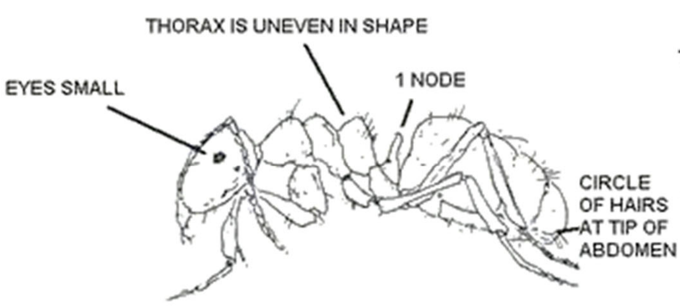
"RED" CARPENTER ANT
(Camponotus sayi)



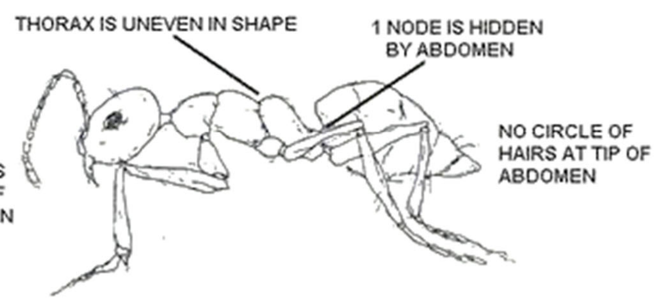
FIELD ANT
(Formica spp.)



SMALL (FALSE) HONEY ANT
(Prenolepis imparis)

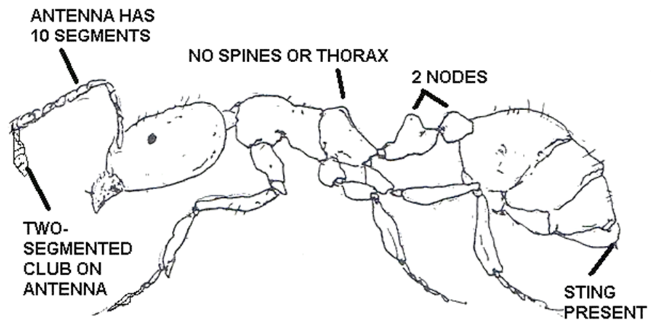


LARGE YELLOW ANT
(Acanthomyops interjectus)

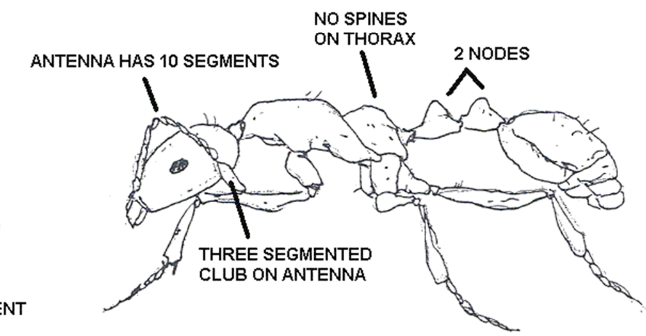


ODOROUS ANT
(Tapinoma sessile)

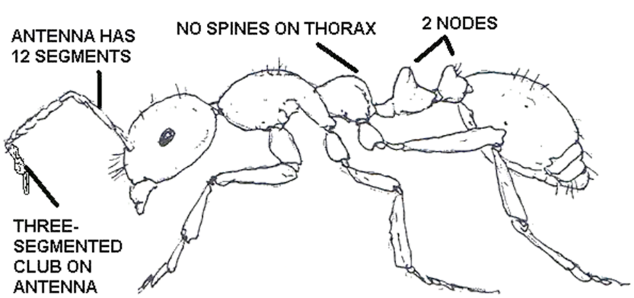
ANT IDENTIFICATION
(2-NODE ANTS)



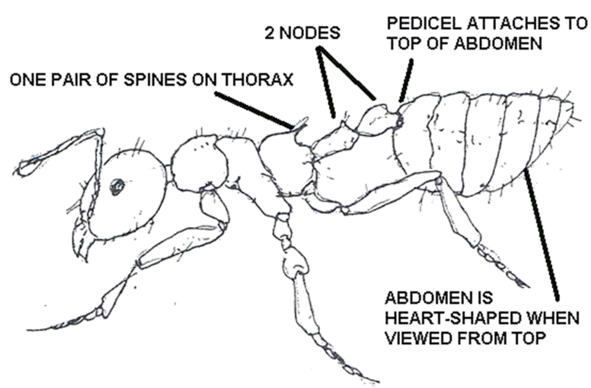
THIEF ANT
(Solenopsis molesta)



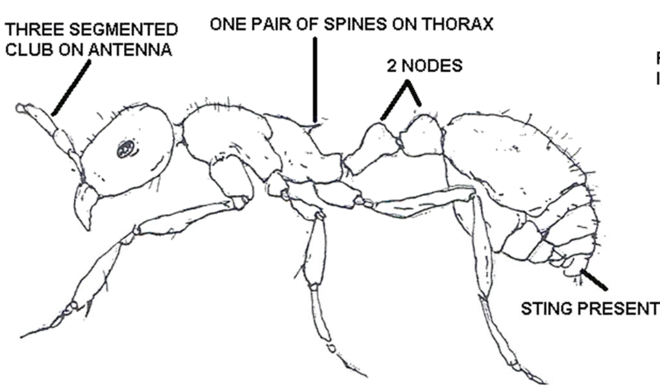
PHARAOH ANT
(Monomorium pharaonis)



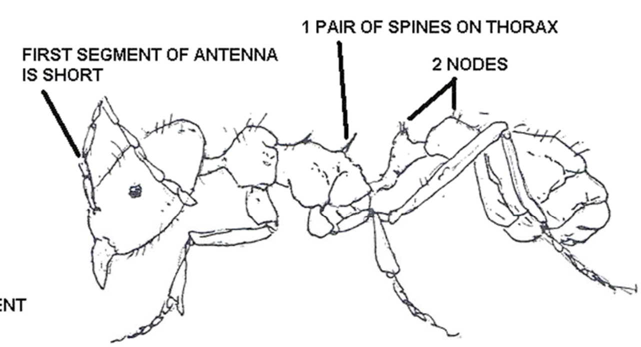
LITTLE BLACK ANT
(Monomorium minimum)



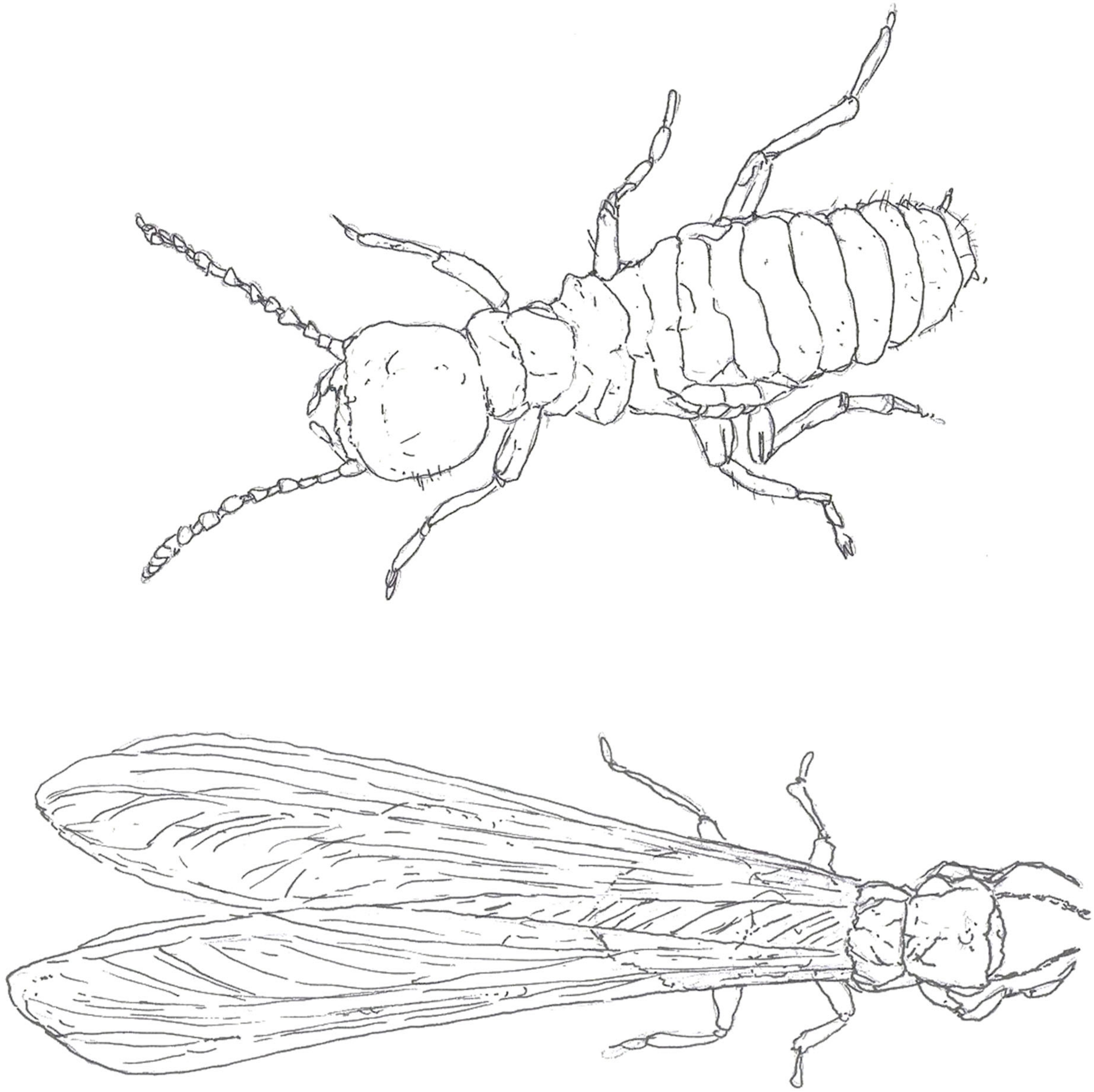
ACROBAT ANT
(Cremastogaster lineolata)



PAVEMENT ANT
(Pheidole spp.)



BIG-HEADED ANT
(Pheidole spp.)

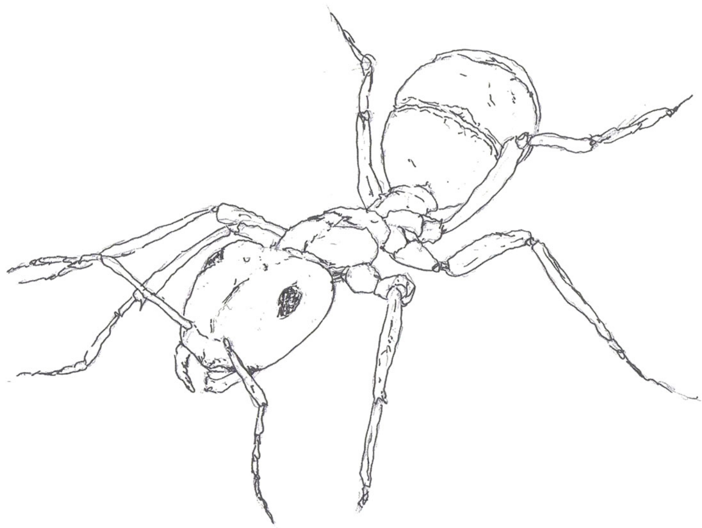


COMMON TERMITE FORMS

Ant Classification Section

We would like to classify ants as big or small but this is difficult, so we will classify as one-node verses two-nodes and hidden nodes. Effective management approaches vary with ant species. Use behavioral characteristics such as food and nesting preferences along with physical characteristics to identify ants. A first step in identifying ants is to use a magnifier to determine if they have one or two nodes at the petiole of their abdomen. Locate the petiole, the first portion of the abdomen, and count the number of nodes present.

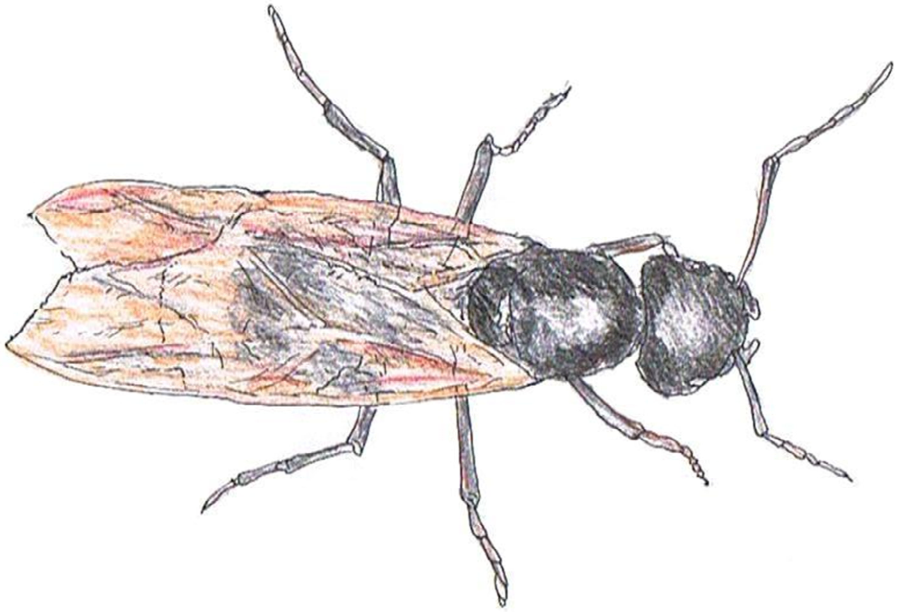
One-Node Ants



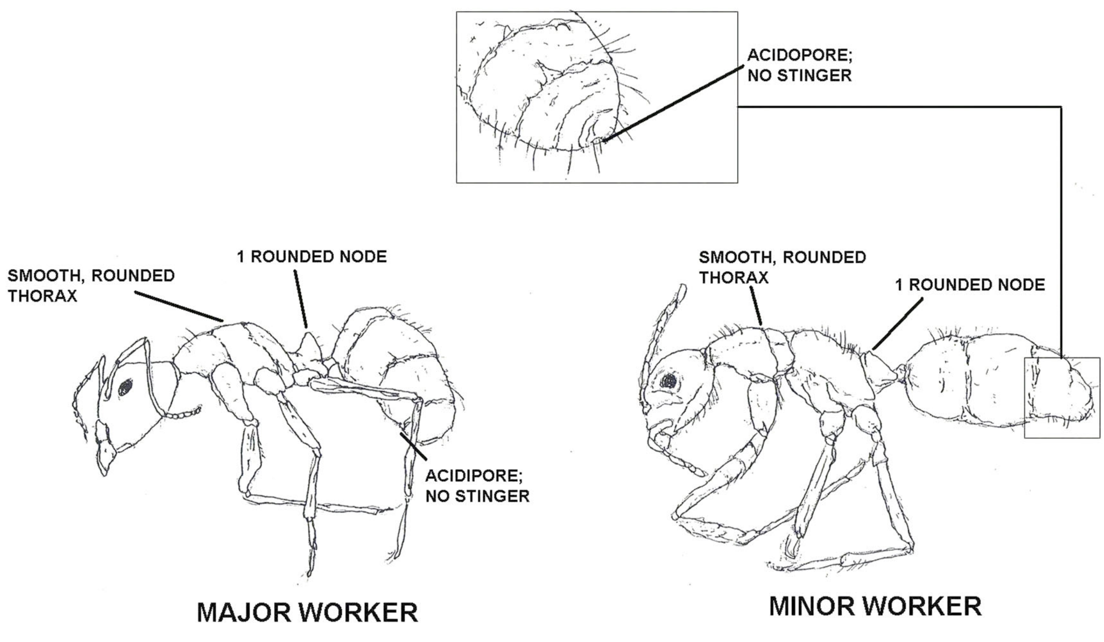
ARGENTINE ANT

Argentine ant (Linepithema humile)
Food: sweets, sometimes proteins. **Nest**: outdoors in shallow mounds. 1/8 inch, dull brown.

Crazy Ants *Various species from Yellow to Raspberry*
Crazy ants vary from red-brown to grayish, and even black in color. Crazy ants are very easy to identify due to their fast, excited movements. Node is often hidden or difficult to see.
Range from 1/12-inch to 1/8-inch in length. Various colors.

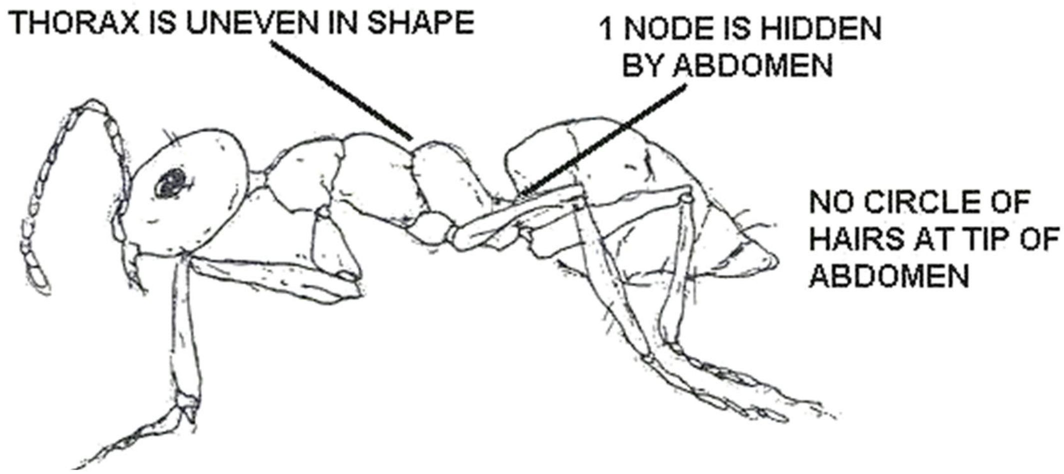


CARPENTER ANT QUEEN



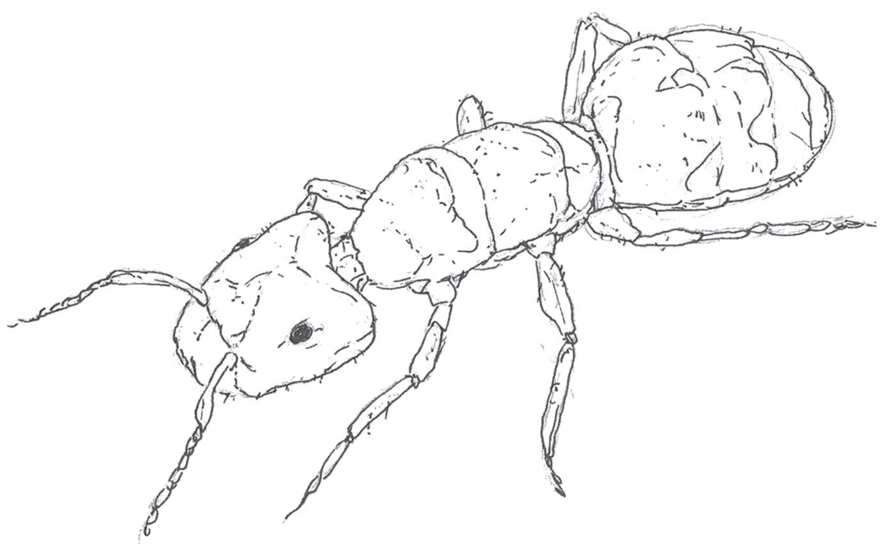
CARPENTER ANT

Carpenter Ant (Camponotus spp.)
Food: Sweets. **Nest**: in tree stumps, firewood, fence posts, hollow doors or window frames; deposit sawdust like frass outside of nests. Large, 1/4 to 1/2 inch, black or bicolored red or black.



ODOROUS ANT (TAPINOMA SESSILE)

Odorous House Ant (*Tapinoma sessile*)
Food: sweets, sometimes proteins. **Nest**: in shallow mounds in soil or debris, or indoors in wall voids, around water pipes or heaters. 1/8 inch, dark brown to shiny black; very strong odor when crushed.



VELVETY TREE ANT

Velvety Tree Ant (*Liometopum occidentale*)
Food: sweets and insects. **Nest**: in dead wood such as old tree limbs, stumps, and logs.
1/8 to 1/4 inch, brownish-black head, red thorax, and velvety black abdomen; very distinct odor when crushed

Acacia Tree Ants, often confused with RIFA– 2 Node ant

Bullhorn Acacia is best known for its symbiotic relationship with a species of Pseudomyrmex ant (*Pseudomyrmex ferruginea*) that lives in its hollowed-out thorns. Unlike other acacias, Bullhorn acacias are deficient in the bitter alkaloids usually located in the leaves that defend against ravaging insects and animals. Bullhorn acacia ants fulfill that role.

The ants act as a defense mechanism for the tree, protecting it against harmful insects, animals or humans that may come into contact with it.

These ants live in the hollowed-out thorns for which the tree is named. In return, the tree supplies the ants with protein-lipid nodules called Beltian bodies from its leaflet tips and carbohydrate-rich nectar from glands on its leaf stalk.

These Beltian bodies have no known function other than to provide food for the symbiotic ants. The aggressive ants release an alarm pheromone and rush out of their thorn "barracks" in great numbers.

According to Daniel Janzen, livestock can apparently smell the pheromone and avoid these acacias day and night. Getting stung in the mouth and tongue is an effective deterrent to browsing on the tender foliage.

In addition to protecting A. conigera from leaf-cutting ants and other unwanted herbivores, the ants also clear away invasive seedlings around the base of the tree that might overgrow it and block out vital sunlight.

Antlions – Enemy of Ants

Antlions are a group of insects in the family Myrmeleontidae (sometimes misspelled as "Myrmeleonidae"). The most well-known genus is Myrmeleo. There are about 2,000 species. Strictly speaking, the term "antlion" applies to the larval form of the members of this family, but while several languages have their own terms for the adult, there is no widely used word for them in English. Very rarely, the adults are called "antlion lacewings".

The antlion larva is often called "doodlebug" in North America because of the odd winding, spiraling trails it leaves in the sand while looking for a good location to build its trap, as these trails look like someone has doodled in the sand

An average-sized larva digs a pit about 2 inches deep and 3 inches wide at the edge. This behavior has also been observed in a family of flies, the Vermileonidae, whose larvae dig the same sort of pit to feed on ants. Having marked out the chosen site by a circular groove, the antlion larva starts to crawl backwards, using its abdomen as a plough to shovel up the soil. By the aid of one front leg it places consecutive heaps of loosened particles upon its head, then with a smart jerk throws each little pile clear of the scene of operations.

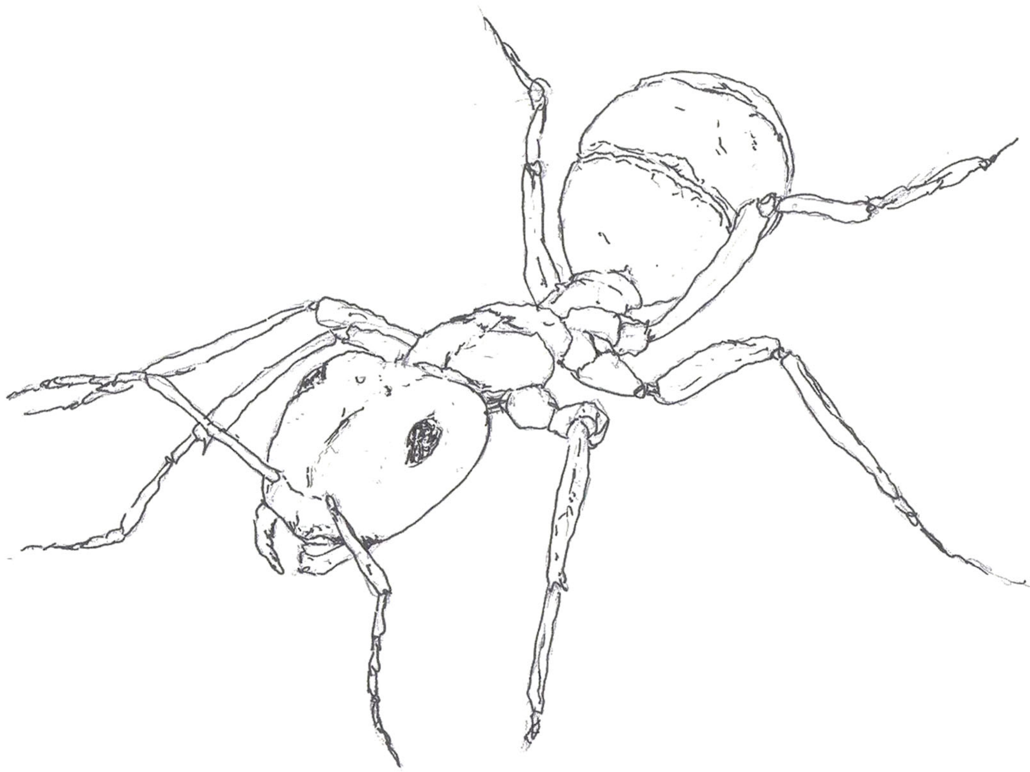
Proceeding thus it gradually works its way from the circumference towards the center. As it slowly moves round and round, the pit gradually gets deeper and deeper, until the slope angle reaches the critical angle of repose (that is, the steepest angle the sand can maintain, where it is on the verge of collapse from slight disturbance). When the pit is completed, the larva settles down at the bottom, buried in the soil with only the jaws projecting above the surface, often in a wide-opened position on either side of the very tip of the cone.

Since the sides of the pit consist of loose sand at its angle of repose, they afford an insecure foothold to any small insects that inadvertently venture over the edge, such as ants. Slipping to the bottom, the prey is immediately seized by the lurking antlion; or if it attempts to scramble up the treacherous walls of the pit, it is speedily checked in its efforts and brought down by showers of loose sand which are thrown at it from below by the larva. By throwing up loose sand from the bottom of the pit, the larva also undermines the sides of the pit, causing them to collapse and bring the prey with them. Thus it does not matter whether the larva actually strikes the prey with the sand showers.

Antlion larvae are capable of capturing and killing a variety of insects and other arthropods, and can even subdue small spiders. The projections in the jaws of the larva are hollow and through this the larva will suck the fluids out of its victim. After the contents are consumed, the dry carcass is flicked out of the pit. The larva readies the pit once again by throwing out collapsed material from the center, steepening the pit walls to the angle of repose.

Antlions are especially abundant in soft sand beneath trees or under overhanging rocks. Apparently the larvae prefer dry places that are protected from the rain. Eventually the larva attains its maximum size and undergoes metamorphosis. The entire length of time from egg-laying to adulthood may take two or three years due to the uncertainty and irregular nature of its food supply. When it first hatches, the tiny larva specializes in very small insects, but as it grows larger, it constructs larger pits and thus catches larger prey.

Argentine Ant - 1 Node ant



ARGENTINE ANT

The **Argentine Ant**, *Iridomyrmex humilus* (Mayr), workers are light to dark brown and generally nest outdoors. It is not common in areas infested by the red imported fire ant. However, it is very common in California. More about this ant later in this course.

History
Since the early 1900s, Argentine ants have spread to almost every corner of the globe by hitchhiking on cargo ships. The invaders live in unusually cooperative super colonies that span states, as in California, and whole regions, like the entire Mediterranean coast, according to Argentine ant specialist Neil Tsutsui of the University of California at Davis.

However, new research is revealing that the impressive expansion of what has become the most common household pest in the world has also led to intense inbreeding that's now causing the ants to become unnaturally hostile toward their own kind.

"It's sort of an unusual state of affairs," said Tsutsui of the Californian super colony. *"Because most invading Argentine ants sprang from a few ants that came on ships, they tend to have a limited variety of genes in their colonies, like any inbred animals would. That's very different from Argentine ants in their native Argentina, however",* said Tsutsui.

"In their native habitat, Argentine ant colonies can hold a wide array of ants with diverse genes. That makes the ants remarkably tolerant of Argentine ants that are genetically different, something they can detect through odor", explained biologist David Queller of Rice University.

“Because the globe-trotting ants have formed very large colonies in foreign lands with very little genetic diversity, they now react unusually aggressively to ants that smell like they are not part of their big, inbred family”, said Tsutsui. *"Very large colonies have a very narrow spectrum of odors,"* Tsutsui explains. So when a diversity-tolerant Argentine native hops off a ship into a super colony's territory, it runs into very hostile ants. In fact, the super colony ants attack preemptively," he said.

“The irony of the situation is that the super colonies actually could benefit from the influx of new genes”, said Tsutsui. *“In large gene pools there are often useful genes hidden in the population that help species survive disease outbreaks or changes in their environment. By attacking the more genetically diverse ants, the super colonies could be hurting their long-term survival”.*

“On a more theoretical level, it's just fascinating to watch a species switch from being unusually cooperative to being aggressive”, said Queller, *“because those are two fundamental survival strategies seen throughout the history of life”.*

Characteristics
Size: About 1/8”-inch long.
Color: Brown. It is most often confused with the odorous house ant, but the node of the Argentine ant has a sharp, pointed peak, while that of the odorous house ant is flat in shape and is hidden by the gaster. A major pest for folks in Southern and Northern California.

The Argentine ant is a one node, small, shiny, brown ant with only one size of worker. Workers are usually about 1/12 to 1/8-inch long. The queen ants are much larger, sometimes reaching 1/4 inch in length. This ant is found throughout the Southeastern United States and California. They nest outdoors under logs, concrete slabs, debris, and mulch. Argentine ants build very large colonies and can move rapidly. During winter months, this ant will move indoors.

Habitat and Behavior
This species is common in the Southeastern US, and is a major problem in Southern California. A 1990 survey of urban pest ants in California showed this ant to comprise 25% of all samples collected. This ant nests outdoors under items on the ground, within landscape mulch, beneath loose bark on trees, under ground cover, in potted plants, and within piles of items, such as lumber, firewood, or under slabs of homes. Like the odorous house ant, the argentine ant may nest indoors, in walls, beneath carpeting, and other suitable voids or spaces.

Super Huge Colonies
Argentine Ants may develop super huge colonies containing thousands of workers and possibly thousands of queens. This species may be one of the most difficult to control. One reason these ants are so successful is the fact that worker ants of individual colonies are friendly towards one another, and colonies will join together to form super colonies. When argentine ant colonies are killed or removed from the area, they can be quickly repopulated by ants from colonies on neighboring properties. An Argentine ant colony can suffer the loss of 99% of the colony's individuals, and the colony can still survive and rebuild. No significant natural enemy of this species currently exists in the United States.

Control
This Ant is Successful and Very Hard to Control Because:
- Different Argentine ant colonies in a same general locale are not enemies. Even the many queens in a single colony or separate colonies are friendly to each other.
- Argentine ants are not too "picky" when choosing a suitable site to infest or colonize. They readily move their nests during the changing seasons and other conditions.
- These pests are omnivorous; they seem to never be in short supply of food.

- Each colony of Argentine ants contains a multitude of workers.
- Each worker is more courageous and harder worker than most ants. Creatures that attempt to prey on Argentine ants are confronted with an army of stubborn bugs that never run from a fight!
- The queens of most ant species are usually egg-laying machines. The queen ant of Argentines actually helps in the care, grooming, and feeding of her young.
- Most species of ant's mate and reproduce by swarming; the Argentine mates in the colony, unexposed to the perils of birds, frogs, lizards, predator insects, and extreme weather conditions. A swarmer reproductive (as seen with fire ants and carpenter ants) has about 1 chance in 1,000 of surviving and successfully reproducing. The Argentine ant queen always succeeds!
- This ant pest has no natural enemies (of any importance) in the United States.

Control of Argentine Ants
Argentine ants are difficult to control for the following reasons:

- All ants are holometabolous (complete metamorphosis), having an egg, larval, pupal, and adult stage. Foraging adult ants are only a fraction of the total colony. Broadcast spraying around the perimeter of the house targets only the foraging adult ants in the colony. Control will be temporary since the colony will simply send out more foraging ants when others are killed.
- The colony supports multiple queens if ant populations are large. If a broadcast spray around the house is the primary method of control, the Argentine ant workers and queens will scatter. When the ants scatter in sufficient numbers, new colonies can be formed. The one main colony can split into several smaller ones, all of which have the potential to grow. Thus, broadcast spraying alone can make the problem worse.
- Unlike many other ant species, Argentine ants from different colonies do not fight. Therefore, their spread is less limited because they are not territorial.
- Even with their large colony size, they are quite mobile and can move from one area to another quickly. A broadcast spray may temporarily alleviate an Argentine ant infestation. But there is a good possibility that the ants will simply move to another area until the chemical breaks down. After the chemical breaks down, the ants will return because they are constantly scouting and foraging for food, water, and nesting sites.
- Heavy mulch against the walls of houses creates pockets of moisture that these ants need.
- Potted plants are a favorite nesting site. Moving infested pots into the house can create an indoor infestation.

These characteristics combine to create a pest control nightmare. Argentine ant control is an ongoing effort. Due to the large size of colonies and their rapid mobility, even if one colony is eliminated, another will move into the area over time.

IPM Control Program
An Integrated Pest Management (IPM) approach offers a greater chance for control of the Argentine ant. An IPM approach incorporates all available control methods into a pest management program. IPM methods include identification, inspection, sanitation, exclusion, and chemical strategies.

Collection Tip
One way to collect ants for identification is to place a dab of honey or sugar water in the center of an index card. Place the index card covered in ants into a plastic bag, and then place the bag in the freezer. The cold temperatures will slow the ants down or kill them. When they are immobilized, the ants can be easily tapped into a vial of alcohol and submitted for identification.

Inspection
Find the source of the ants. Place bait or granules where the ants are foraging or nesting. Generally, Argentine ant trails will be conspicuous. If trails are not obvious, placing an index card with a dab of honey or sugar water where ants have been seen may help locate established trails as ants recruit to the sugar source. In general, treatments are not effective if they are not placed where ants are found.

Sanitation
- Eliminate sources of moisture (such as leaky faucets, plumbing, and free-standing water) and food because these ants are scavengers.
- Clean windows of dead insects. These ants will feed on dead insects.
- Remove the food source if ants are trailing to food. With a mild detergent, wipe ant trails after food is removed to erase the trail pheromone. The trail pheromone is a special chemical that foraging ants lay down to guide other foraging ants to food or to a new nesting place.
- Spray the ants with soapy water from a spray bottle. This will often temporarily halt ant problems if insecticide use is of concern around food or other sensitive areas. Soap breaks the surface tension of the water, causing the ants to drown.
- Check potted plants for ants before bringing the plants indoors. One way to check for ants is to water the soil thoroughly to force ants out of the soil.

Physical Exclusion
- Caulk cracks and crevices in the house.
- Keep branches from coming in contact with your house (ants will walk on them into the house).

Chemical
- Apply chemicals judiciously. Precision spot treatments at points of entry into the house, such as around window sills and door thresholds, may be effective. Broadcast spraying for these ants is unwise. A liquid insecticide will make the area repellent to ants. Ants will not feed on a bait that is placed in the vicinity of a repellent liquid insecticide.
- Bait stations designed for outdoor and indoor use have been reported to be effective in killing these ants. Look for products with delayed toxicants, such as hydramethylnon and sulfluramid. The toxicant must be slow-acting, because if ants die in the immediate area of the bait, other ants will avoid the area and not feed on the bait.
- 1 percent boric acid in a 10 percent sugar solution is a homemade remedy for many sweet-loving ants, such as the Argentine ant. There are several disadvantages to this bait. First, it is very slow-acting. Second, because the colonies are so large, they must be given a constant supply, which means the homeowner would have to repeatedly check on the bait. Even then, control is not guaranteed. The only advantage is that this bait is inexpensive.

Insecticides
In areas of active colonies, treat walls and ceiling voids through cracks and crevices with non-repellent boric acid dust and make bait placements. Keep the ants in the area long enough to get the slow-acting toxicants to the main colony where the workers, larvae and queens are poisoned. (A delayed-action stomach poison is recommended.) Repellent insecticides, such as pyrethrins, will move the colonies, spreading them further throughout the building.

Research has shown that it is best to use bait placement only where active ant trails are found. This ensures feeding, since some ants have not been able to find the bait even when only one inch away from the bait stations. Intersect the ant trail with bait on a cotton swab taken from the station to ensure instant feeding. Bait preference may change during the season due to changing needs of the developing colonies. An effective bait is a 99 percent boric acid formulation mixed at a 5 percent concentration by weight in mint apple jelly (about two level tablespoons of powdered boric acid per 10 ounces of mint apple jelly). Another bait is 2 percent boric acid and 98 percent light corn syrup.

Methoprene
A commercial bait called methoprene (Pharorid) is marketed for use by pest control operators in a bait that consists of liver, honey, and sponge cake. It is often difficult to use the bait ants prefer; as ants feed on one compound, another compound placed less than 1/4-inch away will be ignored until the ants spill over into the second bait.

Boric Acid
Boric acid and methoprene baits work slowly, sometimes taking 15 to 40 weeks or more before ant eradication. A bait containing hydramethylon (same as in Maxforce roach bait stations) gives quicker results, 2 to 35 days, according to certain pest control operators.

Bait stations may include jumbo size plastic drinking straw sections, medicine (pill) dispensing cups, plastic vial caps and/or drafting (masking) tape.

Placement can be made on the rear lip of kitchen counters, at plumbing pipe-wall junctions, on window sills, behind wall electrical outlets, above door frames, etc., in less accessible areas of pets or young children. There may be increased or new ant feeding activity during the early part of the baiting program. No other pesticides, heavy-duty cleaners, or paints should be used during the baiting periods to discourage ant feeding.

Bendiocarb
Applications of bendiocarb (Ficam), which is odorless, can give fast eradication of ants if treatments are thorough. Ficam 76 percent WP and 91 percent dust is labeled for licensed commercial and pest control operators. The bait products most recommended for Pharaoh ant control include: (boric acid plus mint apple jelly (Drax), hydramethylnon (Maxforce), methoprene (Pharorid), bendiocarb (Ficam), propoxur (Baygon) and sulfluramid (Pro-Control)).

After bait stations are placed, one will see ants trailing to and from these bait stations. Do not spray or disturb the ants or bait stations. Ants must be allowed to carry the bait back into their nest where the active ingredient in the bait will eliminate the colony.

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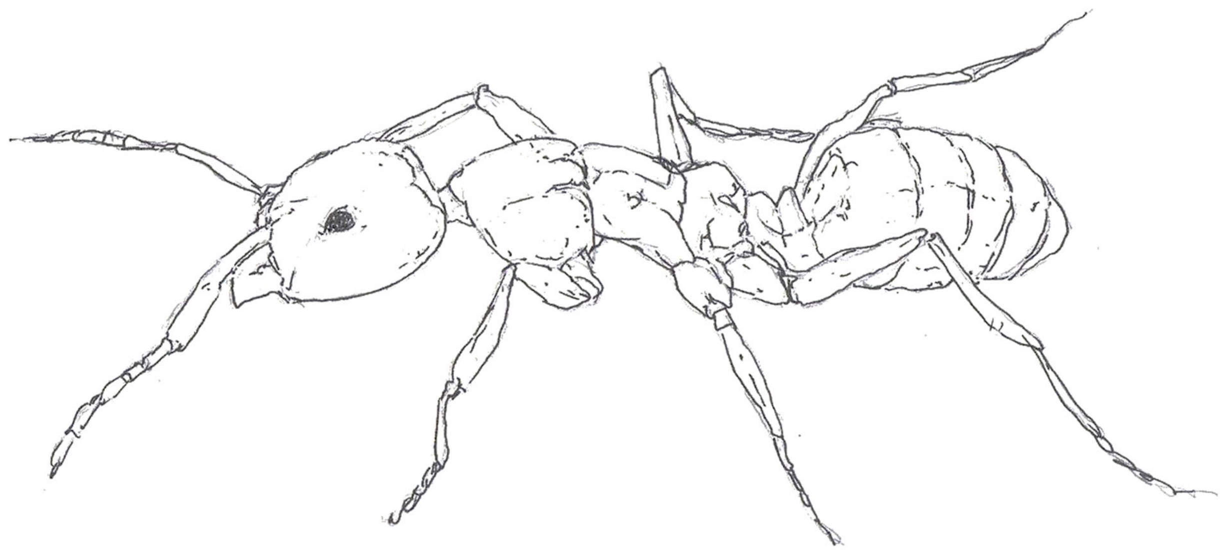
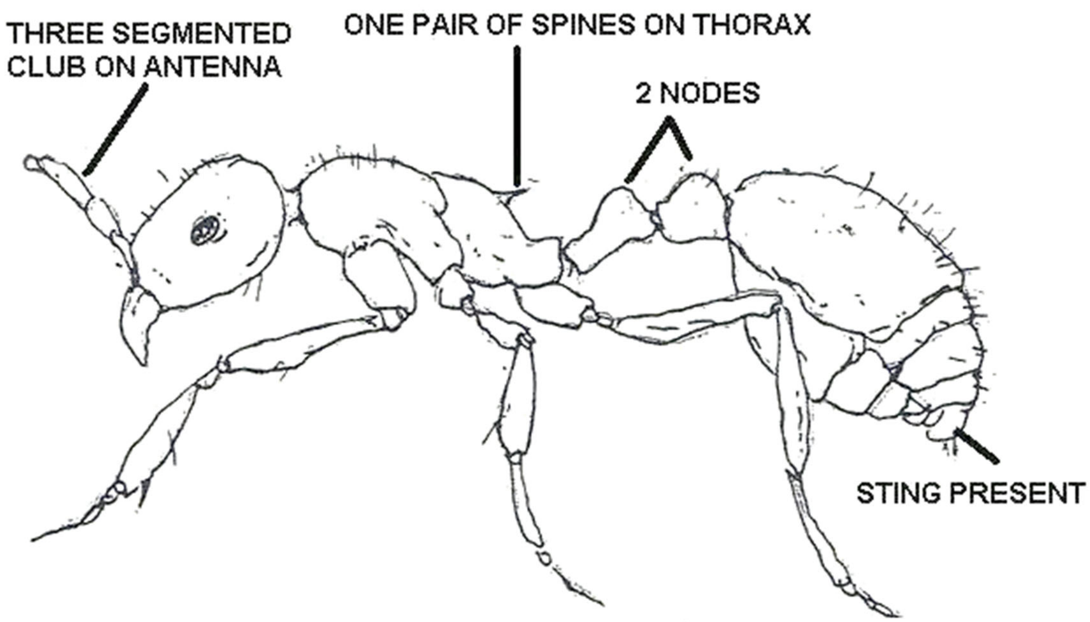
No endorsement is intended for products mentioned, nor is criticism meant for products not mentioned. The author and Technical Learning College (TLC) assume no liability resulting from the use of these recommendations.



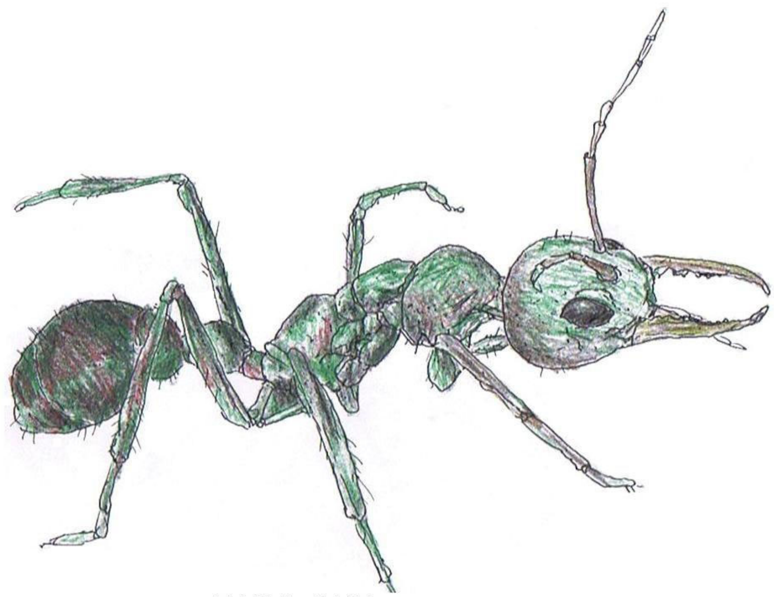
ARGENTINE ANT



PAVEMENT ANT

(Pheidole spp.)

Bull or Bull Dog Ant - 1 Node ant



BULL ANT

Myrmecia, often called bulldog ants, bull ants, inch ants, sergeant ants, jumper ants or jack-jumpers (although jack jumper only applies to members of the M. pilosula species group), is a genus of ants. Bull ants can grow to over 40 mm (1.6 in) in length, with the smallest species 15 mm (0.59 in) long.

Bull ants eat small insects, honeydew (a sweet, sticky liquid found on leaves, deposited from various insects), seeds, fruit, fungi, gums, and nectar. The adult ants mainly eat nectar and honeydew, but the ant larvae are carnivores that eat small insects brought back to them by hunting worker ants. The workers can also regurgitate food back in the nest so other ants can consume it. Foes of bull ants are the black ants, which despite being much smaller, use their much greater numbers to overwhelm bull ant colonies.

Bull ants are fierce little creatures. The sting of a bull ant is not barbed and does not remain in the victim, unlike the sting of a bee. The bull ant can sting again and again repeating its dose. The bull ant's stinger is located in the abdomen. The jaws of the bull ant workers are quite gentle unlike many other ants. They feed on other insects and things such as honeydew from scale insects. The queen bull ant leaves the nest at night to forage and supplement the food supply of her progeny, the baby bull ants.

These ants have a red head and thorax but the abdomen are black. They make their nests underground and have quite extensive tunnel systems. You can usually identify a bull ant's nest by the mound of dirt with rather large opening, sometimes several openings at the top. The dirt is loosely scattered around the mound and two or three bull ant guards (soldiers) can often be seen in the immediate area keeping a sharp eye out for any possible intruders.

Formicidae (order Hymenoptera)
There are about 8000 species of ants in the insect family Formicidae (order Hymenoptera). Ants live just about all over the world but they generally prefer warmer climates. They range from as little as 2mm to 25mm in size.

Ants live eight to ten weeks passing through a four-stage life cycle, - egg - larva - pupa and adult. The workers are the females and do the labor of the nest while the larger ones are the soldiers, defending the colony. At certain times of the year many ant species produce winged males and queens. These fly into the air where they mate (with the male dying soon afterwards). The fertilized queen ant then establishes a new nest and spends the rest of her life laying eggs for her colony.

In general, ant baits can be found as:
- Granules for broadcast
- Liquids
- Gels
- Ready-to-use, tamper resistant containers

Perimeter Insecticide Treatments
The most commonly used method for controlling carpenter ants is treating the perimeter of a home with a dust or spray. There are several products available for this type of application, but Suspend SC, Talstar Concentrate and Cynoff WP are the best. When used in accordance with their labels they work well. However, these treatments do not keep ants from entering a home from overhead trees and power lines. Also, as a stand-alone treatment, they rarely eliminate ants inside voids and walls.

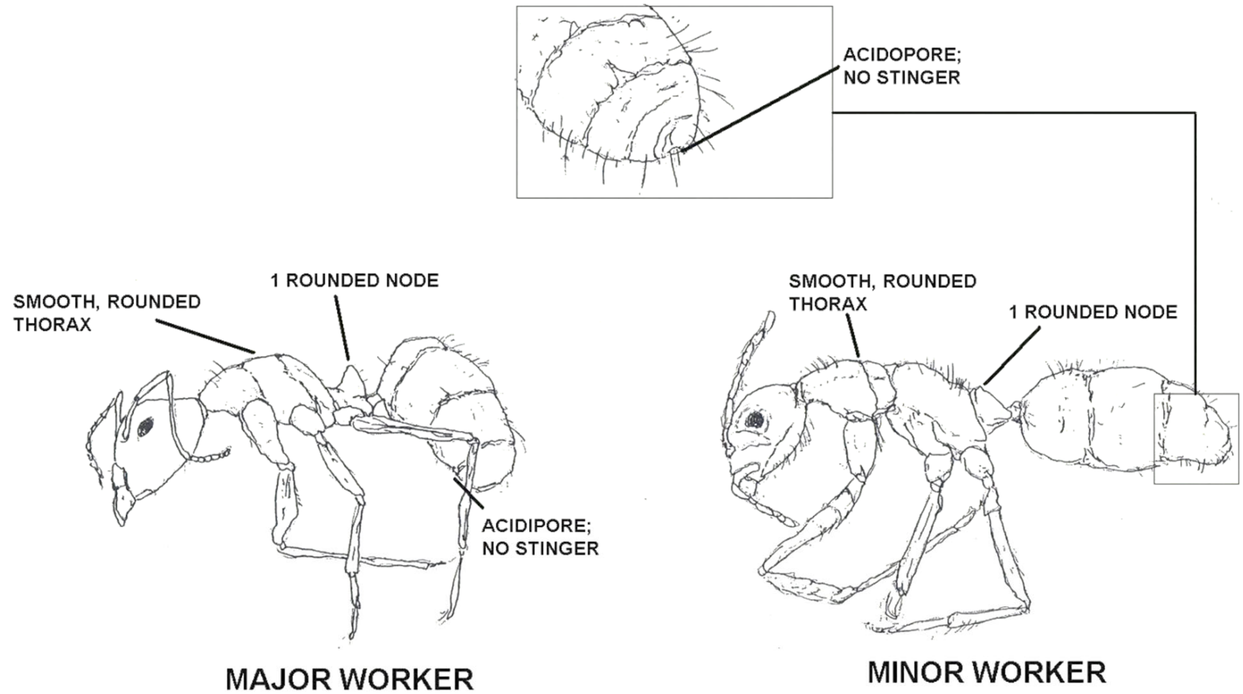
Recommended Products and Treatment
Baiting is the preferred treatment over typical residual spraying, to eliminate the entire colony. The use of residual sprays or dusts will cause stress on the colonies, causing them to split into sub-colonies that scatter to other areas in the structure. This is also called budding. After spraying, the problem can be worse than at the beginning. When you bait, you will want a slow-acting bait. Quick-kill insecticides and baits will only kill the foraging ants, not allowing the foraging ants to take the bait back home to feed the queen, nest workers and brood. If the current ant bait that you are using is not acceptable to the ants (if they are not visiting the bait), it is recommended that you change the baits. Ants require carbohydrates sugars, proteins, and greases. They find a variety of these sources in nature. Examples are: other insects (proteins and greases), nectar, aphid honeydew, and plant products (sugar and carbohydrates).

The Recommended Products for the Protein/Grease Eating Cycle Would Be:
- Maxforce Ant Bait Stations
- Flourguard Ant Bait Stations
- Maxforce Ant Granulars
- Advance Carpenter Ant Bait

The Recommended Products for the Sugar Eating Cycle Would Be:
- Maxforce Ant Killer Bait Gel
- Uncle Albert's Gel Bait
- Revenge Liquid Ant Bait
- Maxforce Granular Ant Bait is an excellent choice for the outside, feeding all their dietary needs.
- Ant bait stations such as: Ant Cafes small or large plastic cubes (that snap shut) that keep the gel or dry granulated bait inside, may serve to keep the baits intact.
- Dr. Moss Liquid Ant Bait can be applied to areas where ants are foraging. For use of Dr. Moss Liquid Ant Bait, you should use the Dr. Moss Liquid Ant Bait Station

Perimeter Treatment with Good Residual Sprays Such As:
- Suspend or Demon WP can at times prevent these ants from entering the structures.

Carpenter Ants - 1 Node ant – *Wood Destroyer*



CARPENTER ANT

Carpenter ants are large (about 3/8” to 1/2" long) and black or red. Carpenter ants are usually larger than most other house- infesting ants. They vary in color from a dull black or reddish yellow color to a combination of black and dull red or reddish-orange. Worker ants range in size from 5/16 to 7/16 inches long. Carpenter ants tunnel into wood to form nest galleries. If they go unnoticed for several years, they may cause structural damage. Outdoors, the ants use dead trees or tree limbs, stumps, logs or areas under stones as nesting sites.

Once the carpenter ant nest has been located, control is relatively easy. Treatment options include use of a bait or residual contact insecticide applied as a dust or spray to the nest. Read and follow the product label for best results. It may be necessary to drill small holes in the wall voids, baseboards, and window and doorsills to reach the nest or major part of the colony. Nests can also be removed and infested wood replaced, if feasible.

Carpenter ants are most active in the evening hours, foraging for all kinds of food, both inside the house and outside. By following the ants, you may be able to tell where the nest is. Because carpenter ants keep the tunneled galleries very clean and push the sawdust and dead insect parts out small holes in the wood, a small, fresh pile of sawdust under the nest timber is the usual sign of an active carpenter ant nest. Once a nest is found, treatment is usually easy with either an insecticide dust or spray. Injection of insecticide into wall voids or the nest itself may be necessary to reinsure complete control.

To prevent further carpenter ant infestations, trim all trees and bushes so branches do not touch the house and correct moisture problems such as leaky roofs and plumbing. Paint and/or seal exposed wood construction before it becomes wet. Replace previously ant-infested wood, rotted or water-damaged wooden parts of the structure and eliminate wood/soil contacts. Remove dead stumps on the property and store firewood off the ground and away from the structure.

Unlike other home-inhabiting ants, carpenter ants cause structural damage to wood by tunneling and nesting inside wood structures. However, they rarely nest in sound wood, but consistently invade wood that has become wet and started to decay.

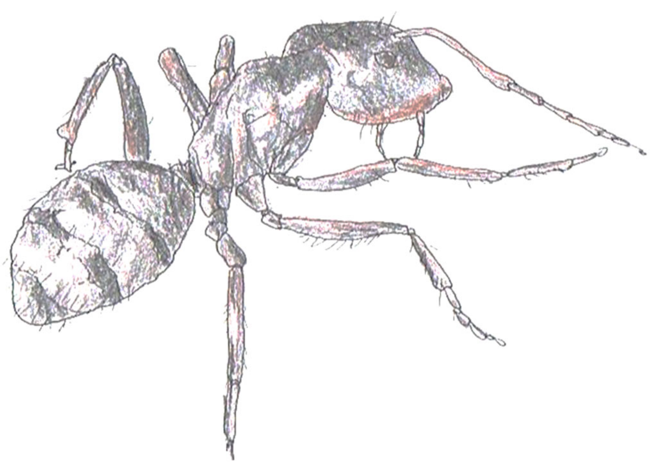
The best way to control carpenter ants that inhabit a dwelling is to find the nest and destroy it. Insecticide sprays inside the home will kill some of the worker ants, but unless the entire nest is treated, the queen will continue to produce additional members of the colony. Locating a nest can be difficult because nests may be in locations within the walls or roof rafters. At this point, some homeowners may prefer to work with a professional pest control company. The most likely places to find carpenter ant nests are where wood has been wet and weathered, such as rotting timbers about the foundation, window sills, porches, around leaky plumbing, and in rafters under a leaky roof.

Carpenter ants nest in moist wood including rotting trees, tree roots, tree stumps, and logs or boards lying on or buried in the ground. They can also nest in moist or decayed wood inside buildings. Wood decay may be caused by exposure to leaks, condensation, or poor air circulation. Nests have been found behind bathroom tiles; around tubs, sinks, showers, and dishwashers; under roofing, in attic beams, and under subfloor insulation; and in hollow spaces such as doors, curtain rods, and wall voids. Carpenter ants may also nest in foam insulation.

Carpenter Ant Colony

A parent carpenter ant colony sometimes establishes one or more satellite nests in nearby indoor or outdoor sites. Satellite nests are composed of workers, pupae, and mature larvae. A satellite nest does not require moisture because the workers do not tend eggs (the eggs would dry out without sufficient humidity). For this reason, satellite nests can be found in relatively dry locations, such as insulation, hollow doors, and sound wood.

The workers of satellite colonies move readily between their nest and the parent colony. In late summer, winged reproductives (i.e. queens and males) may emerge from pupae transported into satellite colonies. They may appear in structures in late winter and early spring as they swarm from a satellite nest. In order to eliminate carpenter ants nesting indoors, you need to locate and destroy their nest.



BLACK CARPENTER ANT

The nest may be located by careful and patient observations of worker ants, especially between sunset and midnight during spring and summer months when carpenter ants are most active. To follow carpenter ants without startling them, use a flashlight with a red film over the lens—ants cannot see red light. You can increase your chances of following workers to their nest by setting out food that is attractive to carpenter ants. Place food in areas where you find workers.

Many foods are attractive to carpenter ants, including honey or other sweet foods. During spring, carpenter ants are particularly attracted to protein sources, such as tuna packed in water. (Carpenter ants are not attracted to tuna packed in oil.) Set out small pieces of tuna for the ants to take back to their nest. It is easier to follow the ants when they are carrying food. With patience and perseverance, you can follow the ants back to their nest.

Other signs that indicate an active nest is nearby include small piles of coarse sawdust or wood shavings, consistent indoor sightings of large numbers of worker ants, i.e. 20 or more and large numbers of winged ants indoors. Carpenter ants typically swarm from late winter through spring. Also pay attention to areas where steady moisture is or has been a problem; firewood stored in an attached garage, next to the foundation, along an outside wall, or in a basement; areas around the plumbing or vent entrances; and trees with branches overhanging the house. These are possible sources of carpenter ant nests.

Sound Detection
Sound detection may be helpful in locating a nest. An active colony may make a dry, rustling sound that becomes louder if the colony is disturbed. This sound, thought to be a form of communication, is made with the mandibles (jaws) and is not related to wood chewing. When trying to detect carpenter ants, tap the suspected area and then press an ear to the surface in order to hear any sound. If one nest is found, watch for evidence of additional nests. More than one nest may be present in a structure.

Carpenter Ant Control Section
The best method to control carpenter ants is to locate and destroy the nest, replace damaged or decayed wood, and, if they exist, eliminate moisture problems. Eliminating a carpenter ant nest is a difficult and challenging task. It is possible for a homeowner to control carpenter ants on their own efforts. However, in most cases, control should be performed by an experienced pest control applicator like yourself. Only we have the experience and a wider array of products to effectively control a carpenter ant problem. Homeowners can still play a crucial role in control programs by providing information to us, such as when, where, and how many ants were seen.

Indoors
Nests are often concealed in wall voids, ceilings, subfloors, attics, or hollow doors. It is usually necessary for a professional pest control applicator to drill small (about 1/8 inch) holes and apply an insecticidal dust into the nest area. It is best to determine the nest's location as specifically as possible. Control should not be applied randomly through the home. There are no insecticides available to the public that are labeled for this type of application.

If it is difficult to locate the nest, an insecticidal dust can be applied into wall voids through electrical outlets. Carpenter ants commonly travel along electrical wiring and are likely to encounter the insecticides. This method works more slowly than a direct treatment into the nest. Boric acid is available to homeowners to treat wall voids through electrical outlets.
CAUTION: Use extreme care around electrical wiring and take all necessary steps to avoid accidental electric shocks.

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Methoprene
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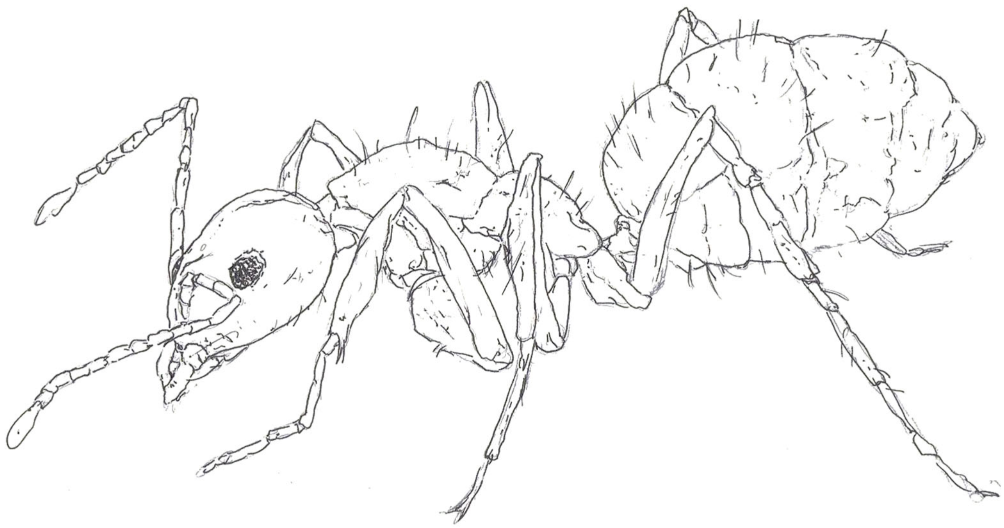
Crazy Ant - 1 Node ant

Workers of the **Crazy Ant**, *Paratrechina longicornis*, are fast-running, grayish black ants with long legs and antennae. They nest primarily outdoors, but they will forage in homes. Although they are omnivorous, they are difficult to attract to ant baits.



YELLOW CRAZY ANT

The crazy ant, P. longicornis, may in some cases create massive, but localized numbers. These species look similar, but have marked differences. Paratrechina longicornis antennae and legs are significantly longer than that of N. sp. nr. pubens. Paratrechina longicornis thorax is extended in length considerably, compared to that of the Nylanderia species. Although the use of color as an identification tool is not to be relied upon, the crazy ant is often jet black in color, especially when compared to the typically reddish-brown of N. sp. nr. pubens.

Colonies of crazy ants are moderate to very populous. The colonies may raise sexuals at any time of the year in warmer regions, but in the seasonal climate of north Florida, alate production is apparently limited to the warm rainy months of May through September (Trager 1984). On warm, humid evenings, large numbers of males gather outside nest entrances and may mill about excitedly. Workers patrol vegetation and other structures nearby. Periodically, a dealate (wingless) queen emerges. Mating was not observed, but Trager (1984) suggested that it occurred in such groupings around the nest entrance. Wings of queens are removed while still callow and males were never observed to fly or use their wings in any way. However, in several cases it has been observed that males frequently appear at lights (Trager 1984).

Pest Status
The crazy ant has achieved pest status across the United States. It has been found on top floors of large apartment buildings in New York, hotels and flats in Boston and in hotel kitchens in San Francisco, California. Marlatt (1930) observed that the crazy ant is a pest in Florida and the Gulf States. As an example, in 1977, modular units were being used as temporary schoolrooms by a North Lauderdale elementary school. The principal reported that the units were so inundated by the ant that students were constantly in a state of turmoil. The invasion reached such proportions that the students' sack lunches were kept in closed plastic bags placed on tables, with each table leg sitting in a pan of water as a barrier to the ant.

It can be a significant agricultural pest as it assists in the distribution and/or protection of phloem-feeding Hemiptera, such as mealybugs, scale insects, and plant aphids (Wetterer 2008).

Foraging and Feeding
Workers are omnivorous, feeding on live and dead insects, seeds, honeydew, fruits, plant exudates, and many household foods. The crazy ant thrives in places such as gasoline stations, convenience stores, and sidewalk cafes where workers may be seen transporting crumbs and insects attracted to lights. They apparently have a seasonal preference for a high-protein diet, and during the summer months may refuse honey or sugar baits. They are attracted to honeydew producing in the spring and fall. They obtain honeydew by tending aphids, mealybugs, and soft scales (Smith 1965). Large prey items are carried by a highly concerted group action (Trager 1984).

Formic Acid
Yellow crazy ants have also been recorded in human communities, where they are seen as agricultural pests, causing outbreaks of sap-sucking insects. They may also cause blindness in humans, especially infants, as people can get formic acid on their hands and then accidentally touch their eyes. Ants also have a detrimental effect on tourism by threatening endemic species and altering the habitat. This was the case on Bird Island after the ants eliminated the island's main attraction, the sooty terns (Sterna fuscata). More worrying is the fact that a recent study indicates that A. gracilipes has the potential to inhabit vast areas of continental Australia. By using potential distribution and climate matching researchers concluded that the ant is capable of occupying most of northern and north-eastern Australia.

New Exotic Invasive Pest
A new exotic invasive pest ant species was found around Houston (Harris County), Texas in 2002, and has begun to spread with human assistance. The ant has yet to be identified to species and is commonly referred to as the Rasberry crazy ant, Nylanderia sp. nr. pubens (LaPolla, et al). Currently, little is known regarding the biology of this ant. The Center for Urban and Structural Entomology at Texas A&M University is investigating food source attraction, colony growth and immature development.

Biology: ID Characteristics & Behavior
Worker ant body characteristics:

Coloration
Adult colony members, including queens, males and workers, are reddish-brown (although lightness or darkness of their body color may vary)

Size
Worker ants are all similar in size (they are monomorphic), with a body length of 1/8 inch.

There is a small circle of hairs (acidopore) present at tip of the abdomen (as opposed to the typical stinger found in most ants), a characteristic of formicine ants found within the Formicinae subfamily. Worker ants have long legs and antennae, although not as long as the crazy ant, P. longicornis, and their bodies have numerous, long, coarse hairs. The antenna has 12-segments with no club.

Colonies
Rasberry crazy ants have been found in enormous numbers. They are social insects that live in large colonies or groups of colonies that seem to be indistinguishable from one another.

- Colonies contain many queen ants (they are polygyne colonies), worker ants and brood consisting of larval and pupal stages. Pupae are "naked" or without cocoons. They periodically produce winged male and female forms called sexuals or reproductives.
- The size of the colony infestations can be large and display super colony (unicolonial) behavior.

Trailing behavior
Rasberry crazy ants foraging trails are quite apparent and individuals forage erratically, hence the typical reference to "crazy" ant. Foraging trails will often follow structural guidelines, however, large trails can be found in open areas.

The EPA is still working on developing a protocol for dealing with Crazy Ants, but there are a few tried and true methods that work on a wide variety of ants. Here are a few steps you can take to control Crazy Ants:

Eliminate Food and Water Sources
This is a good first step because it weakens crazy ant colonies, and weakened ants are vulnerable. Eliminating food and water sources will make your other efforts more effective and it will also prevent ant colonies from re-establishing themselves later. Crazy ants feed on sugar, honeydew from farmed insects (including aphids, cottony scales, mealybugs, soft-type scales, and whiteflies), and dead insects. If you have a hummingbird feeder, make sure that it's a model that the ants can't get into or consider leaving it empty for a few weeks. If you have a no-kill bug trap, make sure to empty it regularly or the crazy ants may be able to feed on the captive bugs. Crazy ants can tolerate water shortages, but they breed quickly in moist environments. So, you may want to consider watering less often and draining your bird baths while the problem is dealt with.

Block Points of Entry into the Home
Your kitchen and pantry are major attractions for ants. When they find bags of sugar, flour, or other packaged foods, it's like finding an open bank vault. They'll rob you blind and then use the resources to breed more foragers. It's a vicious cycle, but you can break it up with a little bit of caulk and fresh gaskets on your windows and doors. As an added benefit, this weatherproofing will also reduce your air conditioning and heating costs!

Find the Nest and Kill the Queen
It's easy to find the source of ant infestation - just follow the workers home! Even though crazy ants are more likely to wander around, they will still form easily traceable lines if they find a good source of food. You can use these lines to trace the ants' path back to a colony and attack them at the source. There are several organic treatments that have proven effective.

Digging up the colony with a shovel can also work, but the ants will attack you to defend their home. Another option is to pour boiling water or waste cooking oil on the nest - it works best if you use a long necked funnel to deliver the liquid deep into the tunnels where the queen and vulnerable larvae are found. Crazy ants are unusual because they often form "supercolonies" with more than one queen. Make sure you get all of the queens, or the colony can recover.

If you prefer a live-and-let-live approach, you can try putting a barrier along one side of the ant colony to redirect the ants away.

Pouring a border of dry molasses along 3 sides of the colony will be somewhat effective at directing crazy ants away from your house or garden, and can be a great option if you don't like one of your neighbors. You can also grow repellent plants around your house to keep ants away - they hate Catnip, Pennyroyal, Peppermint, Sage, and Mint. Tansy can also work, but Tansy is toxic and should be avoided if you have any pets that like to chew on plants (sheep and lambs do this, but so do some dogs and cats).

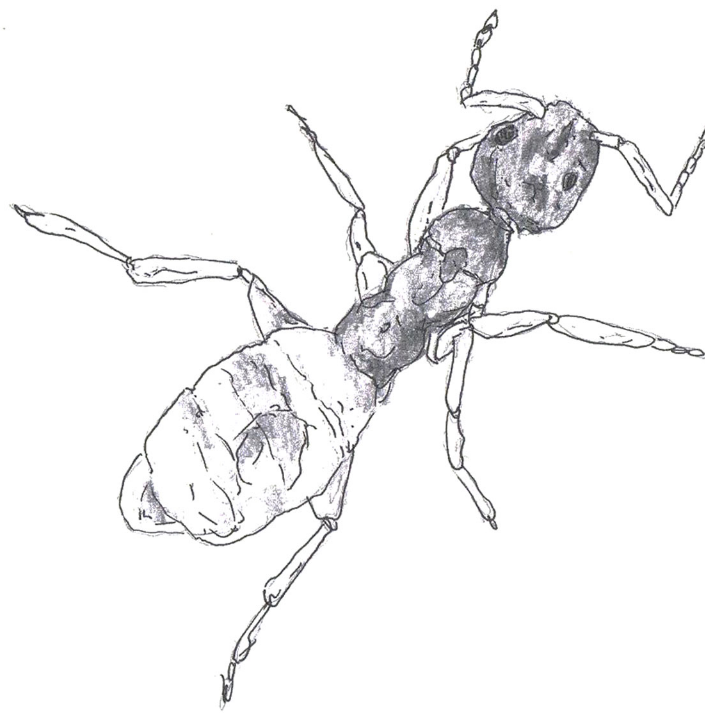
Attraction to Electrical Equipment
It is unclear why this species, like many varieties of ants, is attracted to electrical equipment, including computers and air conditioners and hair dryers. It may be that they sense the magnetic field that surrounds wires with electric current flowing through them.

Or, they might prefer the heat byproduct of resistance in the wires. However, it could simply be that they are searching for food or a nesting location that is easy to defend. Their infestation of electrical equipment can cause short circuits when they chew through insulation. Overheating and mechanical failures can also be caused by high numbers of dead worker ants in electrical devices.

When mounds cannot be located, spraying the window seals and cracks with Cypermethrin (Cynoff EC, Cynoff WP, Demon WP or Demon WP) and using a sweet bait or dual bait such as Gourmet or Advance Dual Choice in the house is a great combination. NEVER use an indoor spray if you are incorporating the use of an indoor ant bait! Such tactics will usually contaminate your bait, resulting in failure to control the pests.

CARPENTER ANT

Ghost Ant *Tapinoma melanocephalum* - 1 Node Ant
Subfamily Dolichoderinae



GHOST ANT

Ghost ants look like tiny, white apparitions who suddenly appear and seem to disappear just as quickly. Workers are 1/16 inch (1.5 mm) in length. The legs, pedicel, gaster, and antennae are pale, almost translucent, in color and the head and thorax are darker. For this reason, the ghost ant is also known in some areas as the black-headed ant.

Reproduction
Colonies of ghost ants tend to be moderate to large in size and multiple queens are present. New colonies are started by "*budding*" where one or more reproductive females, several workers, and possibly some brood (larvae and pupae) migrate to a new nesting site. Their biology is similar to the Pharaoh ant. Ghost ants tend to forage in a more random pattern than the pharaoh ant, so that feeding trails may be more difficult to recognize. These ants have a high need for water and may be commonly found in or around kitchens, baths, or other moisture sources.

Distribution
Ghost ants are found in warm climates and can be a big problem in tropical areas of the world. Ghost ants are highly adaptable in their nesting habits, nesting in a variety of places. Inside, they can be in wall voids, behind baseboards, between cabinets, etc. They also like to nest in the soil of potted plants. Ghost ants have been reported in many areas of the United States, as well as in Canada, Puerto Rico, and the Caribbean Islands. They are a well-established pest in Florida and Hawaii.

The introduction to northern states may have occurred via potted plants shipped from Florida to northern greenhouses. It is also believed that these pests can hitchhike in the luggage of tourists.

Foraging activity indoors is typically concentrated in the kitchen or bathroom, with a high need of water, although any room can be affected. The nesting habits are similar to Pharaoh ants. Outside, they can be found nesting in soil of potted plants, under stones, under and inside logs and firewood. They also nest in cavities and crevices in trees and shrubs. Ghost ants will enter structures, usually by trailing from nests along the foundation or by branches of trees and/or shrubs that contact the structure. They tend to forage in a random pattern; feeding trails may be difficult to spot. Workers forage from these onto and up the walls of buildings, entering through cracks around doors, windows, and soffits. The hollows in pool enclosures also seem to be a prime nesting site. In kitchens, they prefer to forage on sweet items such as packages of marshmallows, syrup, honey, candy and sugar. Ghost ants will also forage on grease deposits although not as readily as they will on sweets. Trails are often very difficult to see due to the tiny size and pale coloration of these ants.

Foraging and Feeding
Workers follow scent trails along the edges of structures for protection. They can often be spotted trailing under the edge of carpets and up the sides of the building, searching for entry points. Ghost ants prefer sweet foods, particularly honeydew secreted by aphids and mealybugs. The ants will herd and protect them from their natural predators, insuring the safety of their living food source. They are also predacious, attacking living insects, eggs and larvae of flies and butterflies. Indoors, ghost ants will seek sweet food such as candy, fruit and sugar.

Implication
Due to their predacious nature ghost ants are a particular problem in butterfly houses and other facilities that raise or store live insects. They will attack the valued insects and will carry off the eggs and larvae of flies and butterflies.

Recommended Products and Treatment
Baiting is the preferred treatment over typical residual spraying, to eliminate the entire colony. The use of residual sprays or dusts will cause stress on the colonies, causing them to split into sub-colonies that scatter to other areas in the structure. This is also called budding. After spraying, the problem can be worse than at the beginning. When you bait, you will want a slow-acting bait. Quick-kill insecticides and baits will only kill the foraging ants, not allowing the foraging ants to take the bait back home to feed the queen, nest workers and brood. If the current ant bait that you are using is not acceptable to the ants (if they are not visiting the bait), it is recommended that you change the baits. Ants require carbohydrates sugars, proteins, and greases. They find a variety of these sources in nature. Examples are: other insects (proteins and greases), nectar, aphid honeydew, and plant products (sugar and carbohydrates).

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Perimeter Treatment with Good Residual Sprays Such As:

- Suspend or Demon WP can at times prevent these ants from entering the structures.

Key

The key to using baits is patience. Applied properly and using a fresh bait product, a broadcast application will give 80% to 90% control, rarely 100%. For instance, Amdro® is the fastest acting, giving maximum control in 3 to 6 weeks. Logic® or Award®, when applied late in the year, may take several months to provide maximum control, but will suppress ant colonies for a year or more. One approach, for example, for heavy imported fire ant infestations is to treat with Amdro® first for fast knockdown, then come back with Logic®/Award® for longer duration of control as ants start to re-infest the area some months in the future. Other baits include Siege®, Award®, Ascend®, and Raid® Fire Ant Killer.

Regular Inspections

Regular inspections and service are necessary to find and treat new colonies as they move in from neighboring properties. These perimeter treatments can keep your home or business pest free. We suggest a regular treatment on the exterior with Demand, Tempo, or Suspend**.**

Locate and Treat Colonies

Drench colonies living in the soil or under items on the exterior with Demand, Suspend, or Tempo. With mulch, be sure to rake it back to get good penetration where colonies may be thriving. Follow up with a broadcast application of granule such as Talstar G. If you know with some certainty where the colony is living inside, then you can treat them directly by drilling a small hole into the wall void at the base (directly above the baseboard) and injecting a dust, such as Delta Dust, Drione, or Borid Turbo.

General tips for limiting ant infestations include:

- Eliminate piles of lumber, bricks, or other debris that could serve as nesting sites for ants.
- Keep landscape mulch less than 2 inches thick and at least 12 inches away from foundations.
- Ensure the sprinkler system does not spray directly onto the foundation.
- Seal as many cracks in the building's exterior as possible.
- Keep tree and shrub branches cut away from touching the building.
- Consider re-landscaping to avoid using plants that are prone to aphids and similar insects. At the very least, treat such plants for aphids regularly.

A thorough inspection both inside and outdoors is crucial to determine ant nest location(s). Inside look primarily near moisture sources (sinks, potted plants, etc.) and secondarily near food sources (sweets stored in cabinets, etc.). Check carpet edges and shoe moldings. Inspect electrical outlets and telephone jacks, especially in the kitchen and bathroom. Check walls around possible entryways (window and door frames, utility lines, weep holes, etc.) for trails of ants as well as along edges and corners. Follow any trails of ants back to their nest. If the ants are associated with an outside/ perimeter wall, then go outside and look for ants trailing along the wall on the opposite side.

If the nest(s) cannot be located, it may be necessary to prebait with sweets such as jelly in short pieces of soda straw to draw the ants out. Place such prebaits where ants have been seen, in electrical outlet boxes, along carpet edges, in food cabinets, etc.

Check these prebait placements in 24-48 hours for activity. If ants cannot then be found coming in from outdoors, use one of the commercial baits for control. Try both protein-based and sweet baits.

Outside, inspect along the foundation wall, patio, and sidewalks by pulling back the grass and/or mulch. Then pull back any mulch at the base of trees and shrubs with a rake. Check debris in tree/shrub crotches using a screwdriver because ants also nest here. Turn over any stones, bricks, logs, firewood, and debris on the ground especially near the foundation; as much as possible such items should be eliminated. Check any branches of trees/shrubs in contact with the structure; these should be trimmed back to eliminate contact. Follow trailing ants back to their nest. Treat nests with an appropriately labeled pesticide. If there is continual ghost ant invasion from the outside, a perimeter treatment using a microencapsulated or wettable powder formulation of pyrethroid should be applied.

Detergent Barrier

Temporary "moats" of detergent and water may be useful during heavy ant invasions.

- Containers of food or food waste which must remain open during working hours can be placed in large, shallow pans filled with water mixed with a small amount of detergent.
- Use this technique to protect potted plants from ants that may be attracted to nectar produced by the plant or to honeydew produced by plant-feeding insects. Elevate the pot above the detergent-and-water mixture by placing it on an overturned saucer. Make sure the limbs and leaves of the plant are not in contact with surfaces that ants could use as bridges.

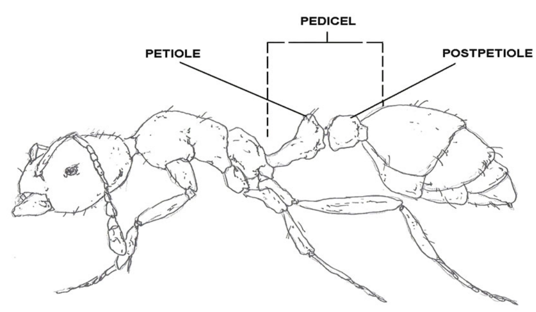
Chemical Controls

At times, non-chemical methods alone prove insufficient to solve the problem. Integrating a pesticide into your management program may be necessary to gain control of the ant problem.

Pesticides must be used in accordance with their EPA-approved label directions. Applicators must be certified to apply pesticides and should always wear protective equipment during applications. All labels and Material Safety Data Sheets (MSDS) for the pesticide products authorized for use in the IPM program should be maintained on file. Do not apply these materials when buildings are occupied, and never apply them where they might wash into drains or sewers. When treating ants, all baits and dusts should be placed in cracks, crevices, and in precise areas where ants are active.

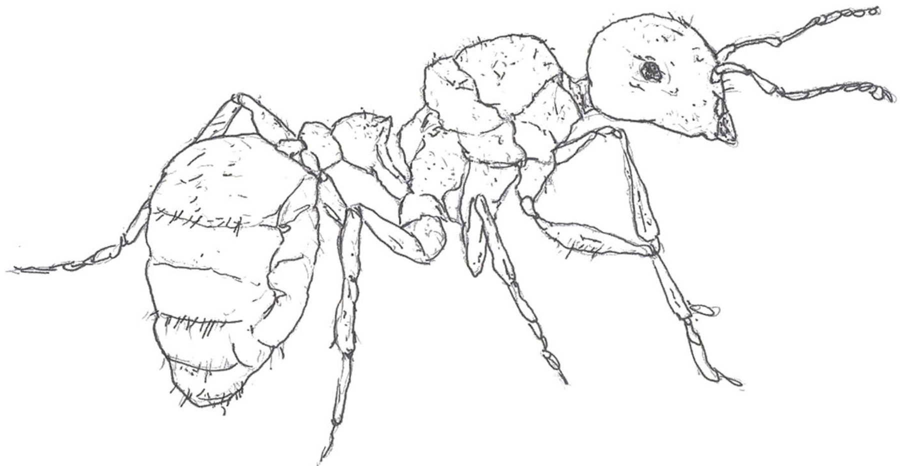
Detergent and Water

When ants invade a classroom or food preparation area, use a mixture of soap and water in a spray bottle. This mixture will quickly kill the ants which can then be wiped up with a sponge and washed down the drain. Each classroom, cafeteria, and food preparation area should be equipped with such a spray bottle so teachers and staff can safely deal with emergencies.



PHARAOH ANT

Harvester Ant - 1 Node Ant –*See Cover Photo*



HARVESTER ANT

Red Harvester ants range from 3/8-inch to 1/2-inch in length. The color varies from red to reddish brown to black, depending on the species. The main food source for red harvester ants usually consists of seeds, which they hoard in great numbers, hence their name. As with most ant species, their mating castes consist of winged alates (reproductives) that reside in the nest until weather permits them to fly away and mate. After that the male usually dies, while the now-fertilized queen returns to the ground to search for a suitable nesting site. Once she has chosen a site, she sheds her wings and begins to reproduce, creating a new colony. She produces "worker ants" for 1–20 years until her death.

Red Harvester Ants can be aggressive and have a painful sting that spreads through the lymph nodes, sometimes causing reactions, especially in animals allergic to their venom. They can also bite ferociously.

Over the years, their numbers have been declining, and this has often been attributed to competition for food with the invasive Red Imported Fire Ant and the argentine ant. Their decline has affected many native species, especially those for which the red harvester ant is a chief source of food, such as the Texas horned lizard. Red harvester ants are often mistaken for fire ants, but are not related to any fire ant species, native or introduced. This class of ants is also known to have both male and female geniuses.

Red harvester ant nests are characterized by a lack of foliage and small pebbles surrounding a hole that is usually at grade. In grassland areas, like ranches, the lack of plant life makes red harvester ant colonies very easy to spot. The mounds are typically flat and broad, 0 to 100 mm (0 to 3.9 in) high, and 300 to 1,200 mm (12 to 47 in) in diameter. There have been reports of even larger denuded areas, on the order of 10 m2 (110 sq. ft). Three to eight trails typically lead away from the mound, like "arms". These trails are used by ants to collect and bring food back to the mound.

"Scout" ants are the first ones out of the mound every morning. They seek food, and mark their path as they return to the mound to alert the worker ants. The worker ants follow the scent trail and collect the food. Other ants, called "middens", spend their time cleaning and tending to the mound. All worker ants and middens are female.

Harvester Ants Description

Adult -- The harvester ants are large ants 5 to 6 mm in length and different species can vary in color from reddish-brown to yellow or black. The pedicel (or stalk) between the abdomen and thorax has two segments. They have elaborate fringes of hairs underneath the head. As is the case with other ants, adults may be winged males or females, or workers (wingless females). Winged ants have two pairs of wings, the anterior pair being much larger than the second pair.
Egg -- The eggs are minute, less than 0.5 mm long, white and elliptical in shape.
Larvae -- The larvae are white and legless. The body is covered with short hairs and is shaped like a crookneck squash or gourd with a small distinct head.
Pupa -- Found in a cocoon, the pupa resembles the larva except that the body is straight and rigid with legs and wings visible.

Key

The key to using baits is patience. Applied properly and using a fresh bait product, a broadcast application will give 80% to 90% control, rarely 100%. For instance, Amdro® is the fastest acting, giving maximum control in 3 to 6 weeks. Logic® or Award®, when applied late in the year, may take several months to provide maximum control, but will suppress ant colonies for a year or more. One approach, for example, for heavy imported fire ant infestations is to treat with Amdro® first for fast knockdown, then come back with Logic®/Award® for longer duration of control as ants start to re-infest the area some months in the future. Other baits include Siege®, Award®, Ascend®, and Raid® Fire Ant Killer.

Regular Inspections

Regular inspections and service are necessary to find and treat new colonies as they move in from neighboring properties. These perimeter treatments can keep your home or business pest free. We suggest a regular treatment on the exterior with Demand, Tempo, or Suspend**.**

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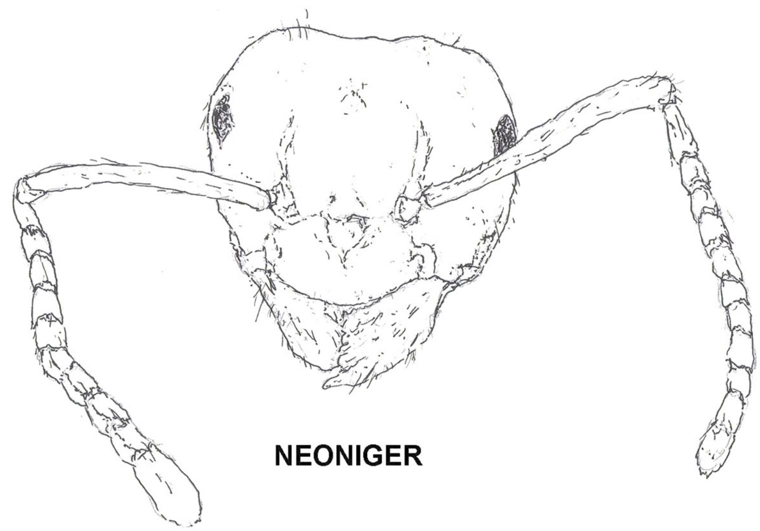
Lasius Neoniger *AKA Cornfield Ant* – 1 Node Ant

Ants can be a real nuisance on golf courses when their nesting and mound-building occur in high-profile areas. Ant mounds disrupt the smoothness and uniformity of putting surfaces, dull mower blades, and can smother closely-mowed turf.



Close-up view of Lasius Neoniger

Lasius neoniger is found commonly in open areas (prairie, parks, rough lawn, roadside) of eastern North America. Golf superintendents often report problems eliminating these pests with conventional insecticides. Further, ant problems in turf seem to be increasing nationwide. One theory to explain this is that residues of chlordane and other highly persistent turf insecticides used in the past have finally declined.

Another theory is that replacement of diazinon (which is highly active on ants) with more target-selective soil insecticides has allowed ants to gain a foothold on golf courses. Whatever the reason, many superintendents need effective ant controls to reduce mound building.

Lately, research has been testing new approaches to managing nuisance ants using delayed-action baits and new classes of insecticides. The results have been promising, and some of these new products are already catching on with superintendents. We are also studying the beneficial aspects of turf-infesting ants, especially their importance as predators on eggs and larvae of other insect pests.

The primary nuisance ant pest of turf is Lasius neoniger, a species that is widespread in the United States. In many areas, Lasius seems to be responsible for most, if not virtually all, ant hills on putting greens. Problems arise when the worker ants excavate underground nest chambers, pushing up small mounds of soil. Lasius is also common in roughs, fairways, lawns, and other sunny turf sites; although there, the mounds are less conspicuous than on greens and tees.

A mature colony of *L. neoniger* consists of one queen, whose only function is to produce eggs and female workers that perform many functions that maintain and help expand the colony over her lifetime which can be four or more years. Males whose only function is to mate once are produced once each year and die after mating.

Development of a new colony begins with a winged virgin female (10X larger than workers) that flies from a mature colony (2,000-10,000 workers). While airborne, she mates with winged males (drones) that have flown from nearby colonies. The drone sperm is deposited into a storage organ (spermatheca) within the body of the female and is released to fertilize eggs she lays throughout her entire lifetime. The queen controls whether or not an egg is fertilized.

If unfertilized, the egg develops into a male. The female mates once and upon landing she chews or rubs off her wings, creates a chamber about an inch into the soil and remains there throughout the winter.

Research in the laboratory has shown that mated females require a “cool down period” (10 weeks at 40ºF) before being able to lay eggs. When soil temperatures rise in the spring, the mated “potential” queen, called a foundress, lays a small number of eggs that develop into larvae which become small workers. The queen feeds these first larvae with regurgitate from her body or eggs she lays. Once these larvae develop into small workers, the foundress can be considered a “queen” with “subjects” whose function is to feed and care for her and her progeny.

The small workers tunnel to the surface and begin foraging for food to feed the queen. Mounds created by these workers may be too small to see. If adequately fed, the new queen will lay many more eggs resulting in normal size workers that forage for food to feed her. Well-fed and cared for the queen increases egg production. The workers collect the eggs and carry them off to “brood chambers” where they will hatch into larvae that develop into more workers.

Recommended Products and Treatment

Baiting is the preferred treatment over typical residual spraying, to eliminate the entire colony. The use of residual sprays or dusts will cause stress on the colonies, causing them to split into sub-colonies that scatter to other areas in the structure. This is also called budding. After spraying, the problem can be worse than at the beginning. When you bait, you will want a slow-acting bait. Quick-kill insecticides and baits will only kill the foraging ants, not allowing the foraging ants to take the bait back home to feed the queen, nest workers and brood. If the current ant bait that you are using is not acceptable to the ants (if they are not visiting the bait), it is recommended that you change the baits. Ants require carbohydrates sugars, proteins, and greases. They find a variety of these sources in nature. Examples are: other insects (proteins and greases), nectar, aphid honeydew, and plant products (sugar and carbohydrates).

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General tips for limiting ant infestations include:

- Eliminate piles of lumber, bricks, or other debris that could serve as nesting sites for ants.
- Keep landscape mulch less than 2 inches thick and at least 12 inches away from foundations.
- Ensure the sprinkler system does not spray directly onto the foundation.
- Seal as many cracks in the building's exterior as possible.
- Keep tree and shrub branches cut away from touching the building.
- Consider re-landscaping to avoid using plants that are prone to aphids and similar insects. At the very least, treat such plants for aphids regularly.

A thorough inspection both inside and outdoors is crucial to determine ant nest location(s). Inside look primarily near moisture sources (sinks, potted plants, etc.) and secondarily near food sources (sweets stored in cabinets, etc.).

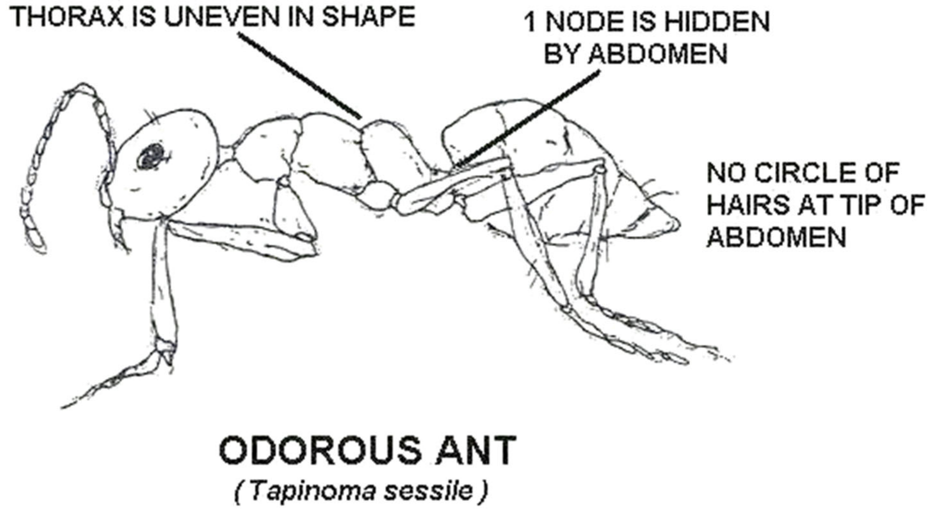
Check carpet edges and shoe moldings. Inspect electrical outlets and telephone jacks, especially in the kitchen and bathroom. Check walls around possible entryways (window and door frames, utility lines, weep holes, etc.) for trails of ants as well as along edges and corners. Follow any trails of ants back to their nest. If the ants are associated with an outside/ perimeter wall, then go outside and look for ants trailing along the wall on the opposite side.

If the nest(s) cannot be located, it may be necessary to prebait with sweets such as jelly in short pieces of soda straw to draw the ants out. Place such prebaits where ants have been seen, in electrical outlet boxes, along carpet edges, in food cabinets, etc. Check these prebait placements in 24-48 hours for activity. If ants cannot then be found coming in from outdoors, use one of the commercial baits for control. Try both protein-based and sweet baits.

Outside, inspect along the foundation wall, patio, and sidewalks by pulling back the grass and/or mulch. Then pull back any mulch at the base of trees and shrubs with a rake. Check debris in tree/shrub crotches using a screwdriver because ants also nest here.

Turn over any stones, bricks, logs, firewood, and debris on the ground especially near the foundation; as much as possible such items should be eliminated. Check any branches of trees/shrubs in contact with the structure; these should be trimmed back to eliminate contact. Follow trailing ants back to their nest. Treat nests with an appropriately labeled pesticide. If there is continual ghost ant invasion from the outside, a perimeter treatment using a microencapsulated or wettable powder formulation of pyrethroid should be applied.

Odorous House Ant – 1 Node Ant



This native species, found throughout the United States, produces a foul odor when crushed. It smells like a "*rotten coconut*". I like to call these nasty little critters "*Piss Ants*". The odorous house ant has become the most common and difficult ant species to control throughout much of the United States. The ant is small (1/8-inch), darkish, and forms distinct trails (shown left) along outdoor and indoor surfaces.

It is often mistaken for the pavement ant, which can readily be controlled with most baits. The most accurate diagnostic difference, visible under magnification, is the absence of a noticeable node or "bump" along the constricted area between thorax and abdomen of the odorous house ant. Pavement ants have two obvious nodes, and fine grooves or striations along the head and thorax. Pavement ants also are more likely to displace bits of soil from their typical nesting location under sidewalks, driveways and other paved areas.

Odorous house ants emit what's been described as a rotten coconut or pine scent when crushed with a finger and sniffed.

Odorous house ants will nest in virtually every imaginable location. They commonly nest outdoors under pavement, stones, mulch, woodpiles, flower pots, and house siding, foraging indoors for food and moisture. Nests also occur indoors within wall cavities, appliances, potted plants, etc., especially near sources of moisture. The nests tend to be mobile; colonies relocate fast and often in response to changes in weather and disturbance.

Appearance
The workers are about 1/16 to 1/8" (2.4 to 3.25mm) long, and their bodies are brown to black. The antennae have 12 segments.

Reproduction
Females in the nest lay one egg daily. It takes an average of 24 days for the young to reach adulthood. The nest colonies range from 100 to 10,000 ants, but can be driven away by invading Argentine ants. Argentine ants generate strong pheromone trails when foraging. They can be easily tracked. In many areas, you will see them pathing three and four abreast.

Inspection
They forage day and night, and their nests can occur in a great variety of situations. Inside, these ants usually construct their nests in wall voids, especially around hot water pipes and heaters, in crevices in sinks, cupboards, etc. Outside, they are found in exposed soil, usually shallow, often located beneath a board, brick, stone walk, etc. They are most likely to enter buildings when their honeydew supply or sweet supply of food is reduced; such as during rainy weather or with leaf fall in the autumn.

Diet
They can feed on anything from other insects, honeydew, seeds, and plant secretions, but do prefer sweets. They are extremely fond of honeydew and attend such honeydew-excreting insects as plant lice (aphids), scale insects, mealybugs, etc.

IPM Control Program
An Integrated Pest Management (IPM) approach offers a greater chance for control of ants. An IPM approach incorporates all available control methods into a pest management program. IPM methods include identification, inspection, sanitation, exclusion, and chemical strategies.

Recommended Products and Treatment
Baiting is the preferred treatment over typical residual spraying, to eliminate the entire colony. The use of residual sprays or dusts will cause stress on the colonies, causing them to split into sub-colonies that scatter to other areas in the structure. This is also called budding. After spraying, the problem can be worse than at the beginning. When you bait, you will want a slow-acting bait. Quick-kill insecticides and baits will only kill the foraging ants, not allowing the foraging ants to take the bait back home to feed the queen, nest workers and brood. If the current ant bait that you are using is not acceptable to the ants (if they are not visiting the bait), it is recommended that you change the baits. Ants require carbohydrates sugars, proteins, and greases. They find a variety of these sources in nature. Examples are: other insects (proteins and greases), nectar, aphid honeydew, and plant products (sugar and carbohydrates).

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- Dr. Moss Liquid Ant Bait can be applied to areas where ants are foraging. For use of Dr. Moss Liquid Ant Bait, you should use the Dr. Moss Liquid Ant Bait Station

Perimeter Treatment with Good Residual Sprays Such As:
- Suspend or Demon WP can at times prevent these ants from entering the structures.

Key
The key to using baits is patience. Applied properly and using a fresh bait product, a broadcast application will give 80% to 90% control, rarely 100%. For instance, Amdro® is the fastest acting, giving maximum control in 3 to 6 weeks. Logic® or Award®, when applied late in the year, may take several months to provide maximum control, but will suppress ant colonies for a year or more. One approach, for example, for heavy imported fire ant infestations is to treat with Amdro® first for fast knockdown, then come back with Logic®/Award® for longer duration of control as ants start to re-infest the area some months in the future. Other baits include Siege®, Award®, Ascend®, and Raid® Fire Ant Killer.

Regular Inspections
Regular inspections and service are necessary to find and treat new colonies as they move in from neighboring properties. These perimeter treatments can keep your home or business pest free. We suggest a regular treatment on the exterior with Demand, Tempo, or Suspend.

Locate and Treat Colonies
Drench colonies living in the soil or under items on the exterior with Demand, Suspend, or Tempo. With mulch, be sure to rake it back to get good penetration where colonies may be thriving. Follow up with a broadcast application of granule such as Talstar G. If you know with some certainty where the colony is living inside, then you can treat them directly by drilling a small hole into the wall void at the base (directly above the baseboard) and injecting a dust, such as Delta Dust, Drione, or Borid Turbo.

General tips for limiting ant infestations include:
- Eliminate piles of lumber, bricks, or other debris that could serve as nesting sites for ants.
- Keep landscape mulch less than 2 inches thick and at least 12 inches away from foundations.
- Ensure the sprinkler system does not spray directly onto the foundation.
- Seal as many cracks in the building's exterior as possible.
- Keep tree and shrub branches cut away from touching the building.
- Consider re-landscaping to avoid using plants that are prone to aphids and similar insects. At the very least, treat such plants for aphids regularly.

A thorough inspection both inside and outdoors is crucial to determine ant nest location(s). Inside look primarily near moisture sources (sinks, potted plants, etc.) and secondarily near food sources (sweets stored in cabinets, etc.). Check carpet edges and shoe moldings. Inspect electrical outlets and telephone jacks, especially in the kitchen and bathroom. Check walls around possible entryways (window and door frames, utility lines, weep holes, etc.) for trails of ants as well as along edges and corners. Follow any trails of ants back to their nest. If the ants are associated with an outside/ perimeter wall, then go outside and look for ants trailing along the wall on the opposite side.

If the nest(s) cannot be located, it may be necessary to prebait with sweets such as jelly in short pieces of soda straw to draw the ants out. Place such prebaits where ants have been seen, in electrical outlet boxes, along carpet edges, in food cabinets, etc. Check these prebait placements in 24-48 hours for activity. If ants cannot then be found coming in from outdoors, use one of the commercial baits for control. Try both protein-based and sweet baits.

Outside, inspect along the foundation wall, patio, and sidewalks by pulling back the grass and/or mulch. Then pull back any mulch at the base of trees and shrubs with a rake. Check debris in tree/shrub crotches using a screwdriver because ants also nest here.

Turn over any stones, bricks, logs, firewood, and debris on the ground especially near the foundation; as much as possible such items should be eliminated.

Check any branches of trees/shrubs in contact with the structure; these should be trimmed back to eliminate contact. Follow trailing ants back to their nest. Treat nests with an appropriately labeled pesticide. If there is continual ghost ant invasion from the outside, a perimeter treatment using a microencapsulated or wettable powder formulation of pyrethroid should be applied.

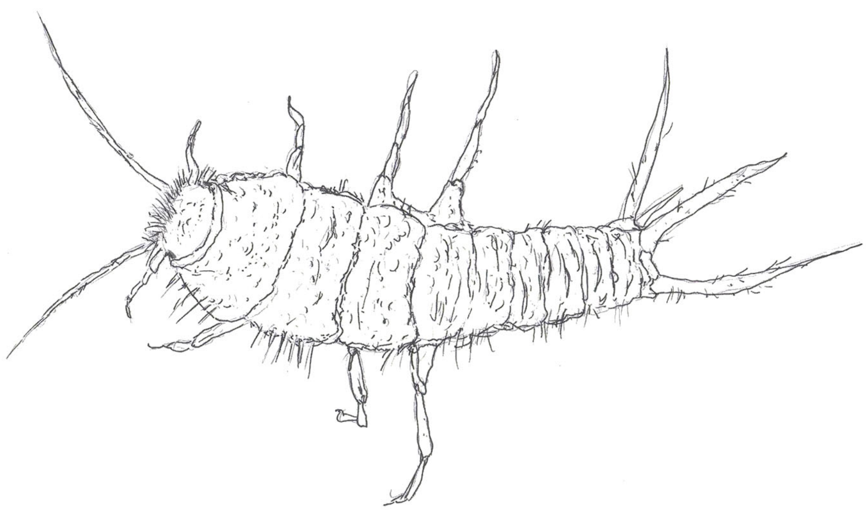
Ant Key Words

Tarsi: A foot. Insect feet are made of several segments and may have pads, hairs, or hooks.

Termite: Any wood-eating insect in the order Isoptera.

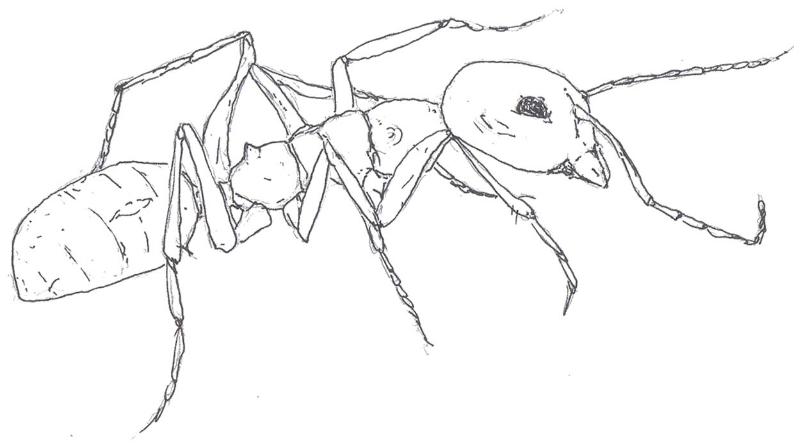
Tramp: A widespread ant species spread by human commerce with a specific syndrome of life history characteristics: extreme polygyny, unicolonial or highly polydomous nest structure and colony reproduction by budding.

Transferred: Collected outside native habitat, without knowledge of established nests.



SILVERFISH

Pyramid Ant – 1 Node Ant



PYRAMID ANT

Pyramid ants are pale orange to dark brown in color. They are slender with a pyramid-shaped projection on its thorax. Range from 1/12-inch to 1/6-inch in length. Nest in soil, sandy soil preferred. Typically, nest has a single entrance surrounded by crater-shaped mound of soil and a single queen per nest. One dark colored species, however, is a temporary parasite on the most common orange species and occupies a number of nests at a time, with multiple queens.

Pyramid ants move quickly and forage in strong, easily detected trails. They are similar to fire ants in that often nest in open, sunny areas, and are rarely found indoors. They can also be found around patios, porches and decks. They feed on other insects and honeydew, and are particularly fond of sweets.

Pyramid ant colonies are small and nesting chambers are formed just below the surface of the soil, providing easy access to the entire colony. Individual colonies can be treated by injecting an appropriate insecticide directly into the entrance hole using a compressed air sprayer. The use of a crack and crevice tip fitted on the spray nozzle should be inserted directly into the entrance hole. Two or three ounces are needed to treat each colony. Colonies found under items on the ground can be drenched with a few ounces of insecticide. Baits containing a sweet attractant can be effective in areas where workers are active but the colony cannot be located.

General tips for limiting ant infestations include:

- Eliminate piles of lumber, bricks, or other debris that could serve as nesting sites for ants.
- Keep landscape mulch less than 2 inches thick and at least 12 inches away from foundations.
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Insecticides
In areas of active colonies, treat walls and ceiling voids through cracks and crevices with non-repellent boric acid dust and make bait placements. Keep the ants in the area long enough to get the slow-acting toxicants to the main colony where the workers, larvae and queens are poisoned. (A delayed-action stomach poison is recommended.) Repellent insecticides, such as pyrethrins, will move the colonies, spreading them further throughout the building.

Research has shown that it is best to use bait placement only where active ant trails are found. This ensures feeding, since some ants have not been able to find the bait even when only one inch away from the bait stations. Intersect the ant trail with bait on a cotton swab taken from the station to ensure instant feeding. Bait preference may change during the season due to changing needs of the developing colonies. An effective bait is a 99 percent boric acid formulation mixed at a 5 percent concentration by weight in mint apple jelly (about two level tablespoons of powdered boric acid per 10 ounces of mint apple jelly). Another bait is 2 percent boric acid and 98 percent light corn syrup.

Step One: Baits
Fire ant baits consist of pesticides on processed corn grits coated with soybean oil. Worker ants take the bait back to the colony, where it is shared with the queen, which then either dies or becomes infertile. Baits currently available include Amdro, Siege, Logic, Award, Ascend, or Raid Fire Ant Killer. Baits are slow-acting and require weeks or months to achieve 80% to 90% control.

Bait Products
Bait products can be used to easily treat large areas effectively. They contain extremely low amounts of toxins.

For best results:
- Use fresh bait, preferably from an unopened container.
- Apply when the ground and grass are dry and no rain is expected for the next 24 to 48 hours.

- Apply when worker ants are actively looking for food, usually in late afternoon or in the evening. To test, put a small pile of bait next to a mound and see if the ants have found it within 30 minutes.
- Apply baits with hand-held seed spreaders. Don't apply baits mixed with fertilizer or seed.
- Baits can be applied anytime during the warm season. When applied in late summer/early fall, ants are still foraging, and it's easier to predict weather patterns. Then the bait can take effect over the winter while you're indoors. Re-apply baits once or twice a year.

Step Two
Individual Mound Treatments
Chemical: With dust products, no water is needed and they act fast. However, they leave a surface residue. Liquid drenches generally eliminate mounds within a few hours and leave little surface residue after application. Granular products are relatively fast acting and usually require putting granules on and around the mound and then sprinkling 1 to 2 gallons of water on them without disturbing the mound. Closely follow directions on the label.

Organic: Pouring 2 to 3 gallons of very hot or boiling water on the mound will kill ants about 60% of the time. Otherwise, the ants will probably just move to another location. Very hot or boiling water will kill the grass or surrounding vegetation that it is poured upon. Other natural or organic methods include mound drench products containing plant derived ingredients (e.g. botanical insecticides) and biological control agents.

Methoprene
A commercial bait called methoprene (Pharorid) is marketed for use by pest control operators in a bait that consists of liver, honey, and sponge cake. It is often difficult to use the bait ants prefer; as ants feed on one compound, another compound placed less than 1/4-inch away will be ignored until the ants spill over into the second bait.

Boric Acid
Boric acid and methoprene baits work slowly, sometimes taking 15 to 40 weeks or more before ant eradication. A bait containing hydramethylon (same as in Maxforce roach bait stations) gives quicker results, 2 to 35 days, according to certain pest control operators.

Bait stations may include jumbo size plastic drinking straw sections, medicine (pill) dispensing cups, plastic vial caps and/or drafting (masking) tape. Placement can be made on the rear lip of kitchen counters, at plumbing pipe-wall junctions, on window sills, behind wall electrical outlets, above door frames, etc., in less accessible areas of pets or young children. There may be increased or new ant feeding activity during the early part of the baiting program. No other pesticides, heavy-duty cleaners, or paints should be used during the baiting periods to discourage ant feeding.

Bendiocarb
Applications of bendiocarb (Ficam), which is odorless, can give fast eradication of Pharaoh ants if treatments are thorough. Ficam 76 percent WP and 91 percent dust is labeled for licensed commercial and pest control operators. The bait products most recommended for Pharaoh ant control include: (boric acid plus mint apple jelly (Drax), hydramethylnon (Maxforce), methoprene (Pharorid), bendiocarb (Ficam), propoxur (Baygon) and sulfluramid (Pro-Control)).

After bait stations are placed, one will see ants trailing to and from these bait stations. Do not spray or disturb the ants or bait stations. Ants must be allowed to carry the bait back into their nest where the active ingredient in the bait will eliminate the colony.

Ant Key Words

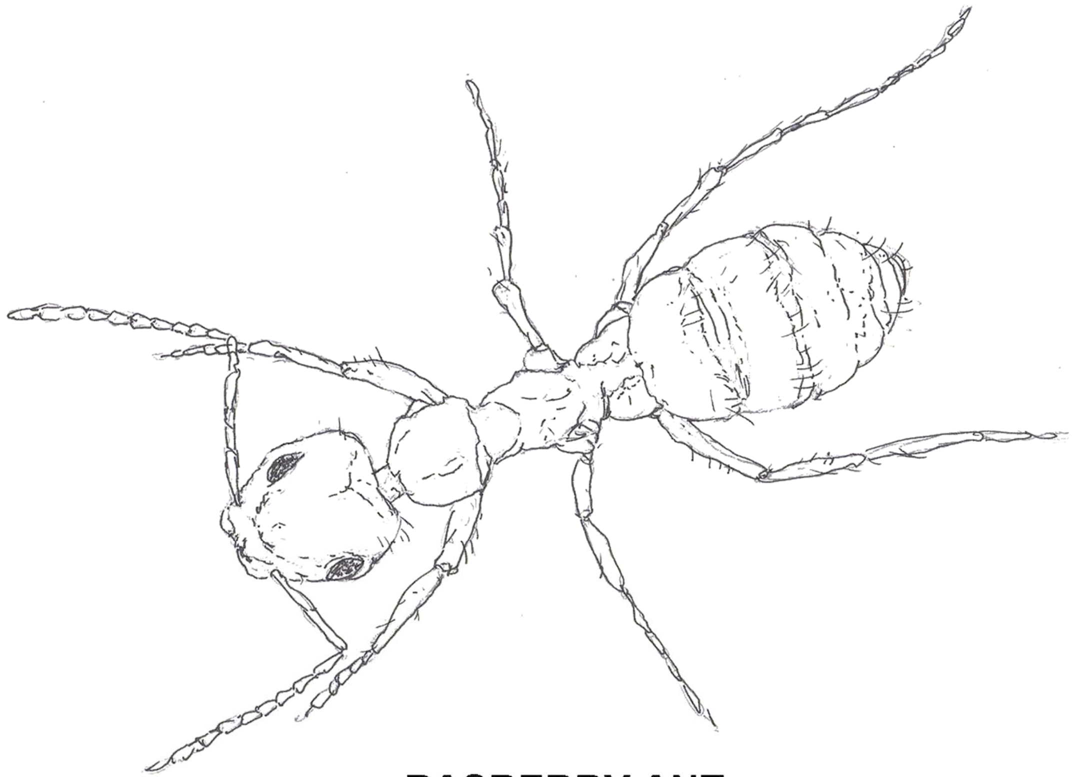
Larval stage (larva, larvae): An immature insect, sometimes used to include all immature stages, even eggs. Usually this term refers more specifically to the feeding stages of insects with complete metamorphosis like grubs, caterpillars, and maggots.

Microbial Pesticide: Bacteria, viruses, fungi and other microorganisms used to destroy or control pests.

Pedipalps: Second pair of appendages of the cephalothorax corresponding to the mandibles of insects.

Pseudergates: Caste found in the lower termites (Isoptera), comprised of individuals having regressed from nymphal stages by molts eliminating the wing buds, or being derived from larvae having undergone non-differentiating molts, serving as the principle elements of the worker caste, but remaining capable of developing into other castes by further molting.

Rasberry Ant *Also see Crazy Ant for more Information* – 1 Node Ant



RASBERRY ANT

The common name being used for Nylanderia sp. nr. pubens is the Rasberry crazy ant. The description of the Rasberry crazy ant is very similar to the species description for Nylanderia pubens, the Caribbean crazy ant. Research on the correct identification of this ant in Texas, including the morphology and phylogenetic characteristics, is ongoing. The ants are about 3 millimeters long (equivalent of one-eighth inch) and are covered with reddish-brown hairs.

The colonies have multiple queens. They feed on ladybugs, fire ants and Atwater's prairie chicken hatchlings, as well as plants. They are able to out-compete fire ants because they reproduce faster. The ants are not attracted to ordinary ant baits, are not controlled by over-the-counter pesticides, and are harder to fully exterminate because their colonies have multiple queens.

Attraction to Electrical Equipment
It is unclear why this species, like many varieties of ants, is attracted to electrical equipment, including computers and air conditioners and hair dryers. It may be that they sense the magnetic field that surrounds wires with electric current flowing through them. Or, they might prefer the heat byproduct of resistance in the wires. However, it could simply be that they are searching for food or a nesting location that is easy to defend.

Their infestation of electrical equipment can cause short circuits when they chew through insulation. Overheating and mechanical failures can also be caused by high numbers of dead worker ants in electrical devices. When mounds cannot be located, spraying the window seals and cracks with Cypermethrin (Cynoff EC, Cynoff WP, Demon WP or Demon WP) and using a sweet bait or dual bait such as Gourmet or Advance Dual Choice in the house is a great combination.

NEVER use an indoor spray if you are incorporating the use of an indoor ant bait! Such tactics will usually contaminate your bait, resulting in failure to control the pests. Simply picking up rocks and debris around the house will also help. If the ants are nesting in the house, the wall voids will need to be dusted with Drione in areas where ant baits are not to be used. Ant infestation are not easy to control and different strategies should be used depending on nest location and food preferences of the ants. Ants can be controlled with a combination of good sanitation, removing pheromone trails, caulking entry points and eliminating active nests. Insecticide sprays and baits can be used to kill foraging ants and destroy nests, but strategies designed to prevent further infestations should be used in conjunction with chemical treatment.

Recommended Products and Treatment
Baiting is the preferred treatment over typical residual spraying, to eliminate the entire colony. The use of residual sprays or dusts will cause stress on the colonies, causing them to split into sub-colonies that scatter to other areas in the structure. This is also called budding. After spraying, the problem can be worse than at the beginning. When you bait, you will want a slow-acting bait. Quick-kill insecticides and baits will only kill the foraging ants, not allowing the foraging ants to take the bait back home to feed the queen, nest workers and brood. If the current ant bait that you are using is not acceptable to the ants (if they are not visiting the bait), it is recommended that you change the baits. Ants require carbohydrates sugars, proteins, and greases. They find a variety of these sources in nature. Examples are: other insects (proteins and greases), nectar, aphid honeydew, and plant products (sugar and carbohydrates).

The Recommended Products for the Protein/Grease Eating Cycle Would Be:
- Maxforce Ant Bait Stations
- Flourguard Ant Bait Stations
- Maxforce Ant Granulars
- Advance Carpenter Ant Bait

The Recommended Products for the Sugar Eating Cycle Would Be:
- Maxforce Ant Killer Bait Gel
- Uncle Albert's Gel Bait
- Revenge Liquid Ant Bait
- Maxforce Granular Ant Bait is an excellent choice for the outside, feeding all their dietary needs.
- Ant bait stations such as: Ant Cafes small or large plastic cubes (that snap shut) that keep the gel or dry granulated bait inside, may serve to keep the baits intact.
- Dr. Moss Liquid Ant Bait can be applied to areas where ants are foraging. For use of Dr. Moss Liquid Ant Bait, you should use the Dr. Moss Liquid Ant Bait Station

Perimeter Treatment with Good Residual Sprays Such As:
- Suspend or Demon WP can at times prevent these ants from entering the structures.

Key
The key to using baits is patience. Applied properly and using a fresh bait product, a broadcast application will give 80% to 90% control, rarely 100%. For instance, Amdro® is the fastest acting, giving maximum control in 3 to 6 weeks. Logic® or Award®, when applied late in the year, may take several months to provide maximum control, but will suppress ant colonies for a year or more.

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Regular Inspections

Regular inspections and service are necessary to find and treat new colonies as they move in from neighboring properties. These perimeter treatments can keep your home or business pest free. We suggest a regular treatment on the exterior with Demand, Tempo, or Suspend**.**

Locate and Treat Colonies

Drench colonies living in the soil or under items on the exterior with Demand, Suspend, or Tempo. With mulch, be sure to rake it back to get good penetration where colonies may be thriving. Follow up with a broadcast application of granule such as Talstar G. If you know with some certainty where the colony is living inside, then you can treat them directly by drilling a small hole into the wall void at the base (directly above the baseboard) and injecting a dust, such as Delta Dust, Drione, or Borid Turbo.

General tips for limiting ant infestations include:

- Eliminate piles of lumber, bricks, or other debris that could serve as nesting sites for ants.
- Keep landscape mulch less than 2 inches thick and at least 12 inches away from foundations.
- Ensure the sprinkler system does not spray directly onto the foundation.
- Seal as many cracks in the building's exterior as possible.
- Keep tree and shrub branches cut away from touching the building.
- Consider re-landscaping to avoid using plants that are prone to aphids and similar insects. At the very least, treat such plants for aphids regularly.

A thorough inspection both inside and outdoors is crucial to determine ant nest location(s). Inside look primarily near moisture sources (sinks, potted plants, etc.) and secondarily near food sources (sweets stored in cabinets, etc.). Check carpet edges and shoe moldings. Inspect electrical outlets and telephone jacks, especially in the kitchen and bathroom.

Check walls around possible entryways (window and door frames, utility lines, weep holes, etc.) for trails of ants as well as along edges and corners. Follow any trails of ants back to their nest. If the ants are associated with an outside/ perimeter wall, then go outside and look for ants trailing along the wall on the opposite side.

If the nest(s) cannot be located, it may be necessary to prebait with sweets such as jelly in short pieces of soda straw to draw the ants out. Place such prebaits where ants have been seen, in electrical outlet boxes, along carpet edges, in food cabinets, etc. Check these prebait placements in 24-48 hours for activity. If ants cannot then be found coming in from outdoors, use one of the commercial baits for control. Try both protein-based and sweet baits.

Outside, inspect along the foundation wall, patio, and sidewalks by pulling back the grass and/or mulch. Then pull back any mulch at the base of trees and shrubs with a rake. Check debris in tree/shrub crotches using a screwdriver because fire ants also nest here.

Turn over any stones, bricks, logs, firewood, and debris on the ground especially near the foundation; as much as possible such items should be eliminated. Check any branches of trees/shrubs in contact with the structure; these should be trimmed back to eliminate contact. Follow trailing ants back to their nest.

Treat nests with an appropriately labeled pesticide. If there is continual ghost ant invasion from the outside, a perimeter treatment using a microencapsulated or wettable powder formulation of pyrethroid should be applied.

Sanitation

- Eliminate sources of moisture (such as leaky faucets, plumbing, and free-standing water) and food because these ants are scavengers.
- Clean windows of dead insects. These ants will feed on dead insects.
- Remove the food source if ants are trailing to food. With a mild detergent, wipe ant trails after food is removed to erase the trail pheromone. The trail pheromone is a special chemical that foraging ants lay down to guide other foraging ants to food or to a new nesting place.
- Spray the ants with soapy water from a spray bottle. This will often temporarily halt ant problems if insecticide use is of concern around food or other sensitive areas. Soap breaks the surface tension of the water, causing the ants to drown.
- Check potted plants for ants before bringing the plants indoors. One way to check for ants is to water the soil thoroughly to force ants out of the soil.

Physical Exclusion

- Caulk cracks and crevices in the house.
- Keep branches from coming in contact with your house (ants will walk on them into the house).

Chemical

- Apply chemicals judiciously. Precision spot treatments at points of entry into the house, such as around window sills and door thresholds, may be effective. Broadcast spraying for these ants is unwise. A liquid insecticide will make the area repellent to ants. Ants will not feed on a bait that is placed in the vicinity of a repellent liquid insecticide.

- Bait stations designed for outdoor and indoor use have been reported to be effective in killing these ants. Look for products with delayed toxicants, such as hydramethylnon and sulfluramid. The toxicant must be slow-acting, because if ants die in the immediate area of the bait, other ants will avoid the area and not feed on the bait.

- 1 percent boric acid in a 10 percent sugar solution is a homemade remedy for many sweet-loving ants, such as the Argentine ant. There are several disadvantages to this bait. First, it is very slow-acting.

- Second, because the colonies are so large, they must be given a constant supply, which means the homeowner would have to repeatedly check on the bait. Even then, control is not guaranteed. The only advantage is that this bait is inexpensive.

Insecticides

In areas of active colonies, treat walls and ceiling voids through cracks and crevices with non-repellent boric acid dust and make bait placements. Keep the ants in the area long enough to get the slow-acting toxicants to the main colony where the workers, larvae and queens are poisoned. (A delayed-action stomach poison is recommended.)

Repellent insecticides, such as pyrethrins, will move the colonies, spreading them further throughout the building. Research has shown that it is best to use bait placement only where active ant trails are found.

This ensures feeding, since some ants have not been able to find the bait even when only one inch away from the bait stations. Intersect the ant trail with bait on a cotton swab taken from the station to ensure instant feeding. Bait preference may change during the season due to changing needs of the developing colonies.

An effective bait is a 99 percent boric acid formulation mixed at a 5 percent concentration by weight in mint apple jelly (about two level tablespoons of powdered boric acid per 10 ounces of mint apple jelly). Another bait is 2 percent boric acid and 98 percent light corn syrup.

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Applications of bendiocarb (Ficam), which is odorless, can give fast eradication of ants if treatments are thorough. Ficam 76 percent WP and 91 percent dust is labeled for licensed commercial and pest control operators.

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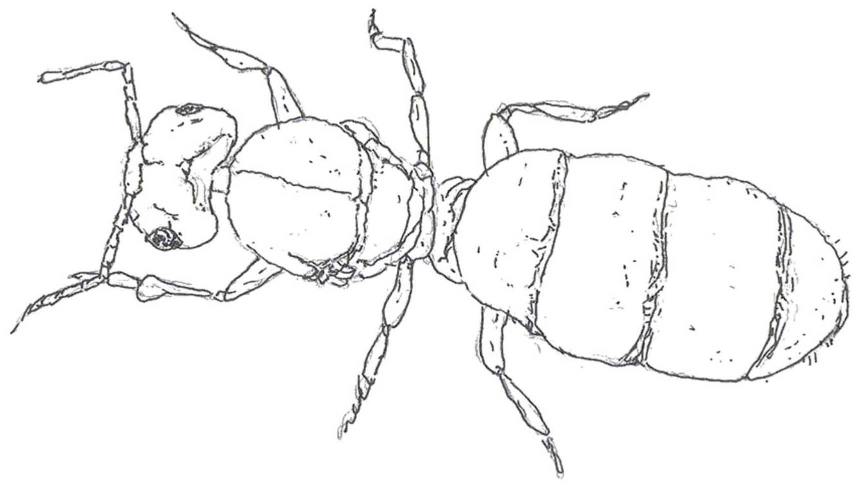
After bait stations are placed, one will see ants trailing to and from these bait stations. Do not spray or disturb the ants or bait stations. Ants must be allowed to carry the bait back into their nest where the active ingredient in the bait will eliminate the colony.

These recommendations are provided only as a guide. It is always the pesticide applicator's responsibility, by law, to read and follow all current label directions for the specific pesticide being used. Due to constantly changing labels and product registration, some of the recommendations given in this writing may no longer be legal by the time you read them.

If any information in these recommendations disagrees with the label, the recommendation must be disregarded.

No endorsement is intended for products mentioned, nor is criticism meant for products not mentioned. The author and Technical Learning College (TLC) assume no liability resulting from the use of these recommendations.

Rover Ant Information and Control – 1 Node Ant
Brachymyrmex spp.



ROVER ANT

Rover Ants were noticed around 40 years ago, but are just now gaining attention as they have become a serious pest problem in many areas of the country. The Rover ant is often mistaken for the little black ant, resulting in failure to control the targeted ant pest.

Unlike the Little Black Ant, the Rover ant has only one queen and can have many colonies in one area. It can be very frustrating to eliminate all of the colonies.

The Rover ant is very small (1/16 to 1/12 of an inch) and can be blonde to dark brown in color. They have one node which has a low peak and is sloped slightly forward of the abdomen is generally carried forward and hides the node. The key to identifying the Rover ant is its 9 segmented antennae which is not clubbed. Another physical characteristic of the Rover Ant is that it does not have a stinger. The workers of this ant species are all one size (monomorphic).

Rover Ants are most often found dead in swimming pools or running vigorously up and down vertical objects such as a blade of grass or the leg of a patio chair. In the wilderness they nest under stones, in the soil or in rotting wood.

In buildings we are finding them in high moisture areas such as bathrooms, kitchens or rooms with past water problems. They can also form sub slab colonies. Rover Ants feed on honeydew which is produced from aphids and mealy bugs. Female winged ablates are three times larger than male workers.

Controlling Rover Ants
By broadcasting a good residual insecticide such as Talstar over lawns and nearby shrubs to kill off the ants, much of their food source (sap sucking insects which provide honeydew) can also be controlled. Exterior surfaces of the home, garage, shed or other structures in infested areas will also help control foraging Rover ants.

Indoor control of Rove Ants will be aided by the exterior spray, but if the indoor populations are too high in number then other actions can be taken.

When indoor sprays are not favorable or practical, use a good bait for sweet feeding ants. Gourmet Ant Bait Gel is an excellent choice for controlling indoor Rover Ant populations, whether they are merely scouting for food or have established colonies in the voids found inside the average home.

When mounds cannot be located, spraying the window seals and cracks with Cypermethrin (Cynoff EC, Cynoff WP, Demon WP or Demon WP) and using a sweet bait or dual bait such as Gourmet or Advance Dual Choice in the house is a great combination. NEVER use an indoor spray if you are incorporating the use of an indoor ant bait! Such tactics will usually contaminate your bait, resulting in failure to control the pests.

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Boric acid and methoprene baits work slowly, sometimes taking 15 to 40 weeks or more before ant eradication. A bait containing hydramethylon (same as in Maxforce roach bait stations) gives quicker results, 2 to 35 days, according to certain pest control operators.

Bait stations may include jumbo size plastic drinking straw sections, medicine (pill) dispensing cups, plastic vial caps and/or drafting (masking) tape.

Placement can be made on the rear lip of kitchen counters, at plumbing pipe-wall junctions, on window sills, behind wall electrical outlets, above door frames, etc., in less accessible areas of pets or young children. There may be increased or new ant feeding activity during the early part of the baiting program. No other pesticides, heavy-duty cleaners, or paints should be used during the baiting periods to discourage ant feeding.

Bendiocarb
Applications of bendiocarb (Ficam), which is odorless, can give fast eradication of ants if treatments are thorough. Ficam 76 percent WP and 91 percent dust is labeled for licensed commercial and pest control operators. The bait products most recommended for Pharaoh ant control include: (boric acid plus mint apple jelly (Drax), hydramethylnon (Maxforce), methoprene (Pharorid), bendiocarb (Ficam), propoxur (Baygon) and sulfluramid (Pro-Control)).

After bait stations are placed, one will see ants trailing to and from these bait stations. Do not spray or disturb the ants or bait stations. Ants must be allowed to carry the bait back into their nest where the active ingredient in the bait will eliminate the colony.

Recommended Products and Treatment
Baiting is the preferred treatment over typical residual spraying, to eliminate the entire colony. The use of residual sprays or dusts will cause stress on the colonies, causing them to split into sub-colonies that scatter to other areas in the structure. This is also called budding. After spraying, the problem can be worse than at the beginning.

When you bait, you will want a slow-acting bait. Quick-kill insecticides and baits will only kill the foraging ants, not allowing the foraging ants to take the bait back home to feed the queen, nest workers and brood. If the current ant bait that you are using is not acceptable to the ants (if they are not visiting the bait), it is recommended that you change the baits. Ants require carbohydrates sugars, proteins, and greases. They find a variety of these sources in nature. Examples are: other insects (proteins and greases), nectar, aphid honeydew, and plant products (sugar and carbohydrates).

The Recommended Products for the Protein/Grease Eating Cycle Would Be:

- Maxforce Ant Bait Stations
- Flourguard Ant Bait Stations
- Maxforce Ant Granulars
- Advance Carpenter Ant Bait

The Recommended Products for the Sugar Eating Cycle Would Be:

- Maxforce Ant Killer Bait Gel
- Uncle Albert's Gel Bait
- Revenge Liquid Ant Bait
- Maxforce Granular Ant Bait is an excellent choice for the outside, feeding all their dietary needs.
- Ant bait stations such as: Ant Cafes small or large plastic cubes (that snap shut) that keep the gel or dry granulated bait inside, may serve to keep the baits intact.
- Dr. Moss Liquid Ant Bait can be applied to areas where ants are foraging.

These recommendations are provided only as a guide. It is always the pesticide applicator's responsibility, by law, to read and follow all current label directions for the specific pesticide being used. Due to constantly changing labels and product registration, some of the recommendations given in this writing may no longer be legal by the time you read them.

Types of Common Building Treatment Applications

Spot treatment is application to small areas where insects walk but will not contact food, utensils, or workers. Such areas are on floors, walls, or bases or undersides of equipment. Spot treatments should not exceed 2 square feet. In many cases, spot treatments are only allowed in non-food areas. Check the label to be sure of the proper
use of spot treatments.

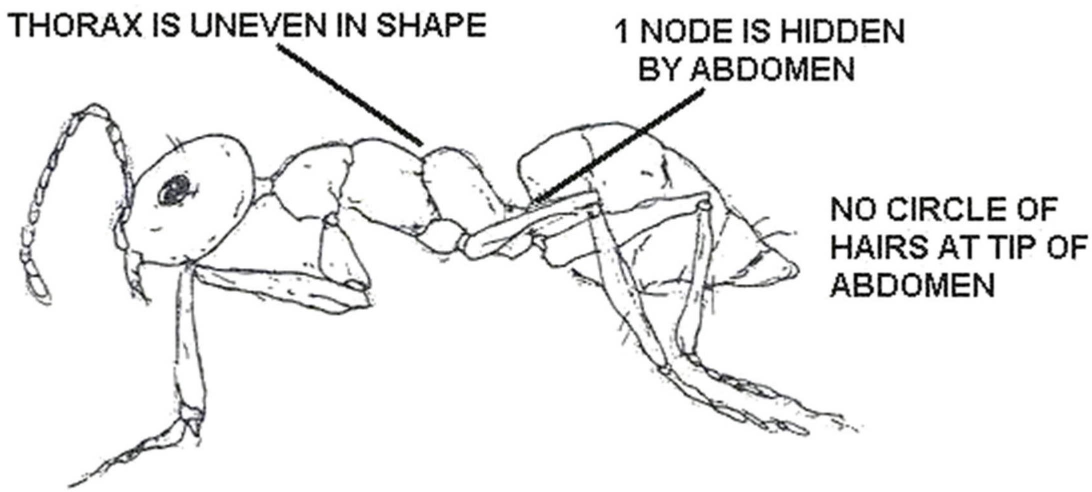
Crack and crevice treatment is the application of small amounts of pesticides into cracks and crevices that pests use to enter buildings. These commonly occur at expansion joints. They occur between equipment and floors. The openings may lead to hollow walls, equipment legs and bases, conduits, motor housings, or junction or switch boxes. You can use liquids, dusts, or baits for crack and crevice treatments. These products can be used in food areas if the pesticides are placed into cracks and crevices.

Residual pesticides may be applied when food establishments are in operation unless the product label prohibits it.

When using *non-residual pesticides* (effects only during the time of treatment) as space treatments (aerosol, ULV and fog), the application should be made when the establishment is not in operation and foods are removed or covered. Food handling surfaces should be cleaned before use.

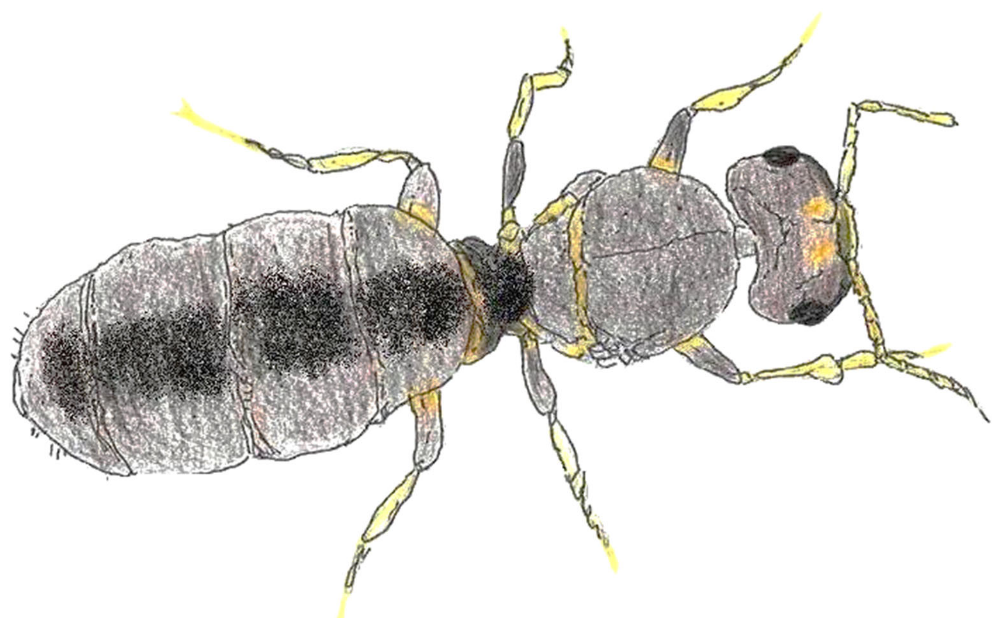
If any information in these recommendations disagrees with the label, the recommendation must be disregarded. No endorsement is intended for products mentioned, nor is criticism meant for products not mentioned. The author and Technical Learning College (TLC) assume no liability resulting from the use of these recommendations.

Hidden Node Ant Section



ODOROUS ANT
(Tapinoma sessile)

Odorous Ant
Odorous House ants are dark brown to black in color. Technical classified as 1 node but difficult to see the node. Typically 1/8-inch long.



Rover Ant
Rover ants are yellow-blonde to dark brown in color, with the abdomen appearing swollen or humped at the front end. Technical classified as 1 node but difficult to see the node. Range from 1/16-inch to 1/12-inch in length.

White-Footed Ant
The white-footed ant is a 1/10 to 1/8 inch (2.5-3 mm) long, black to brownish-black ant. It is called the white-footed ant because the "foot" (which actually is the lower part of the leg known as the tarsus) is yellowish-white.

The waist has only one knob-like node and each antenna has 12 segments. The white-footed ant does not have a sting. Technical classified as 1 node but difficult to see the node

Topic 1 - One Node Ant Identification and Control Section Post Quiz Answers at the rear of Glossary

1. Ants are thick-waisted and have solid antennae. Termites have thinner waists and have antennae that resemble strings of tiny beads.
True or False

2. Ants are distinct in their morphology from other insects in having elbowed antennae, metapleural glands, and a strong constriction of their second abdominal segment into a node-like petiole. The head, mesosoma, and metasoma are the three distinct body segments.
True or False

3. Which ants tunnel into wood to form nest galleries. If they go unnoticed for several years, they may cause structural damage?

4. Once an active carpenter ant nest is found, treatment is usually easy with either a(n) ___________. Injection of insecticide into wall voids or the nest itself may be necessary to reinsure complete control.

5. The best way to control carpenter ants that inhabit a dwelling is to find the nest and destroy it. Insecticide sprays inside the home will kill some of the worker ants, but unless the entire nest is treated, the queen will continue to produce additional members of the colony.
True or False

6. A satellite nest requires moisture because the workers tend eggs (the eggs would dry out without sufficient humidity). For this reason, satellite nests can be found in relatively wet locations, such as insulation, hollow doors, and sound wood.
True or False

Indoors

7. Ant nests are often concealed in wall voids, ceilings, subfloors, attics, or hollow doors. It is usually necessary for a professional pest control applicator to drill small (about 1/8 inch) holes and apply an insecticidal dust into the nest area. It is best to determine the nest's location as specifically as possible.
True or False

Perimeter Insecticide Treatments

8. The most commonly used method for controlling carpenter ants is treating the perimeter of a home with a dust or spray. There are several products available for this type of application, but Ammoniacal copper zinc arsenate and Chromated Copper Arsenate (CCA) are the best.
True or False

Bendiocarb

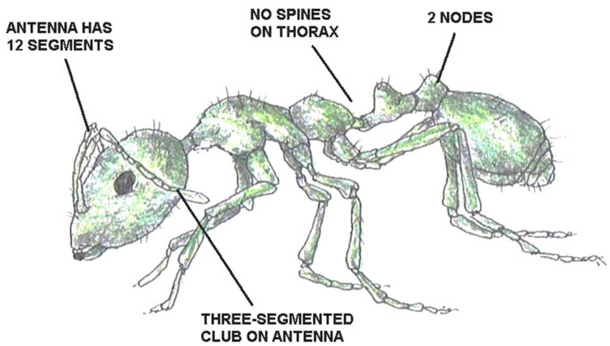
9. Applications of bendiocarb (Ficam), which is odorless, can give fast eradication of ants if treatments are thorough. Ficam 76 percent WP and 91 percent dust is labeled for licensed commercial and pest control operators. The bait products most recommended for Pharaoh ant control include: (boric acid plus mint apple jelly (Drax), hydramethylnon (Maxforce), methoprene (Pharorid), bendiocarb (Ficam), propoxur (Baygon) and sulfluramid (Pro-Control)).
True or False

Harvester Ant - 1 Node Ant

10. Red Harvester Ants are not aggressive and lack a painful stinger.
True or False

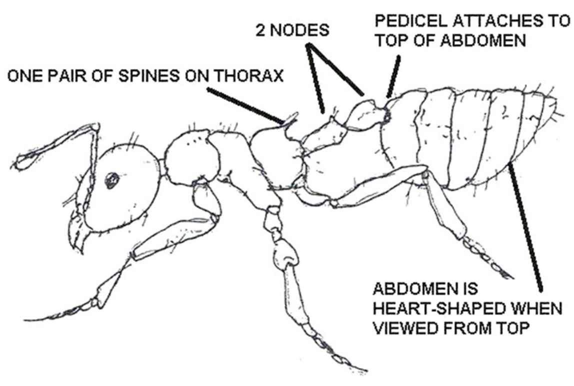
Topic 2 - Two Node Ant Identification and Control Section

Topic 2 - Section Focus: You will learn the basics of two node ant identification and control techniques. At the end of this section, you will be able to understand and describe two node ant control and elimination techniques. There is a post quiz at the end of this section to review your comprehension and a final examination in the Assignment for your contact hours.



LITTLE BLACK ANT

Little Black Ant (*Monomorium minimum*) is a species of ant. Members of the species are tiny and shiny black in color. These ants are pests that are usually found outdoors or in wood inside a home that causes it to decay. Workers are 1/16 inch in length and the queens are 1/8 inch in length. They use recruitment to deal more effectively with large prey. They form colonies with multiple queens. Ants give birth to live pupa. Ant pupa laid by the queen can take just 10 days to mature. Winged ants may fly away and start a new colony if the current colony is overpopulated.

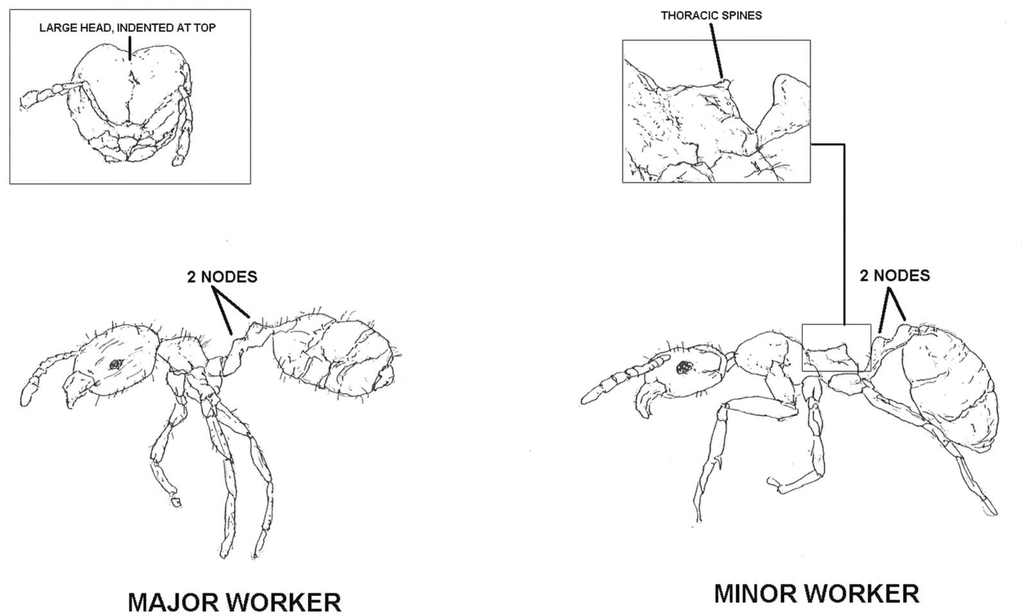


ACROBAT ANT

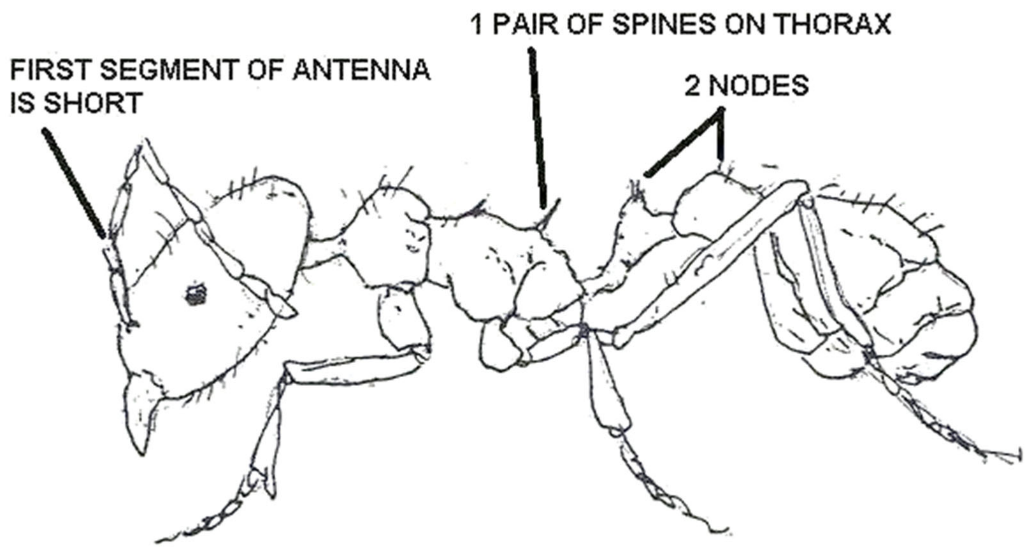
(Cremastogaster lineolata)

Acrobat Ant

Acrobat ants have very shiny bodies that vary in color from light red to dark brown or black. They have a heart-shaped abdomen, and get their name from the unique habit of running with it bent up and over their thorax when bothered or agitated, and may sting or bite. They are often very shiny. Range from 1/8-inch to more than a ¼-inch in length.

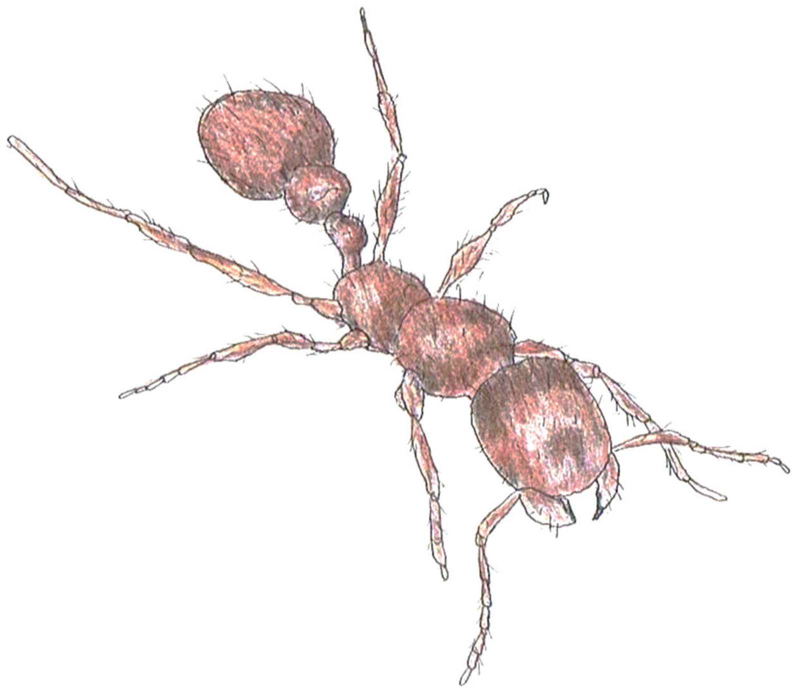


BIG HEADED ANT

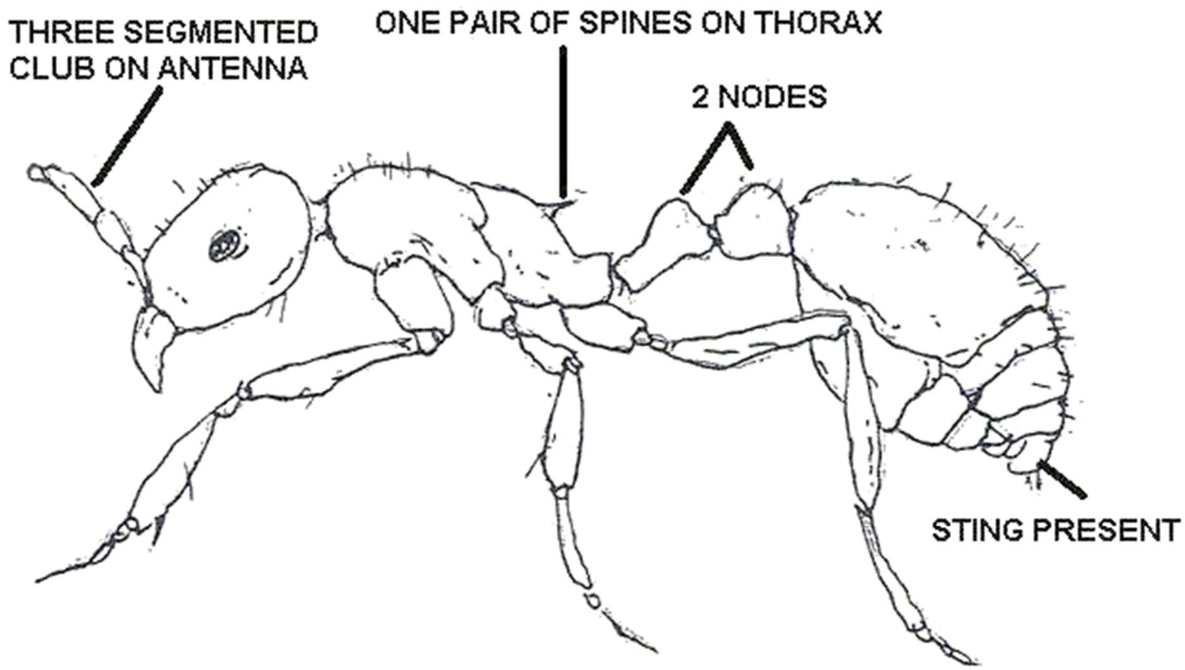


BIG-HEADED ANT
(Pheidole spp.)

Big Headed Ants
Big-headed ants are light brown to dark reddish brown in color. They have two different size workers: major workers heads are very large in proportion to their bodies. The minor workers do not have large heads. Range from 1/16-inch to 1/8-inch in length.



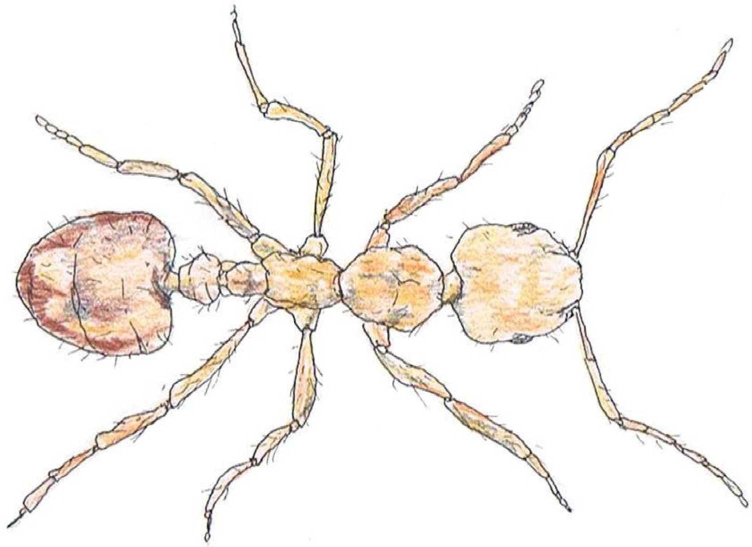
PAVEMENT ANT

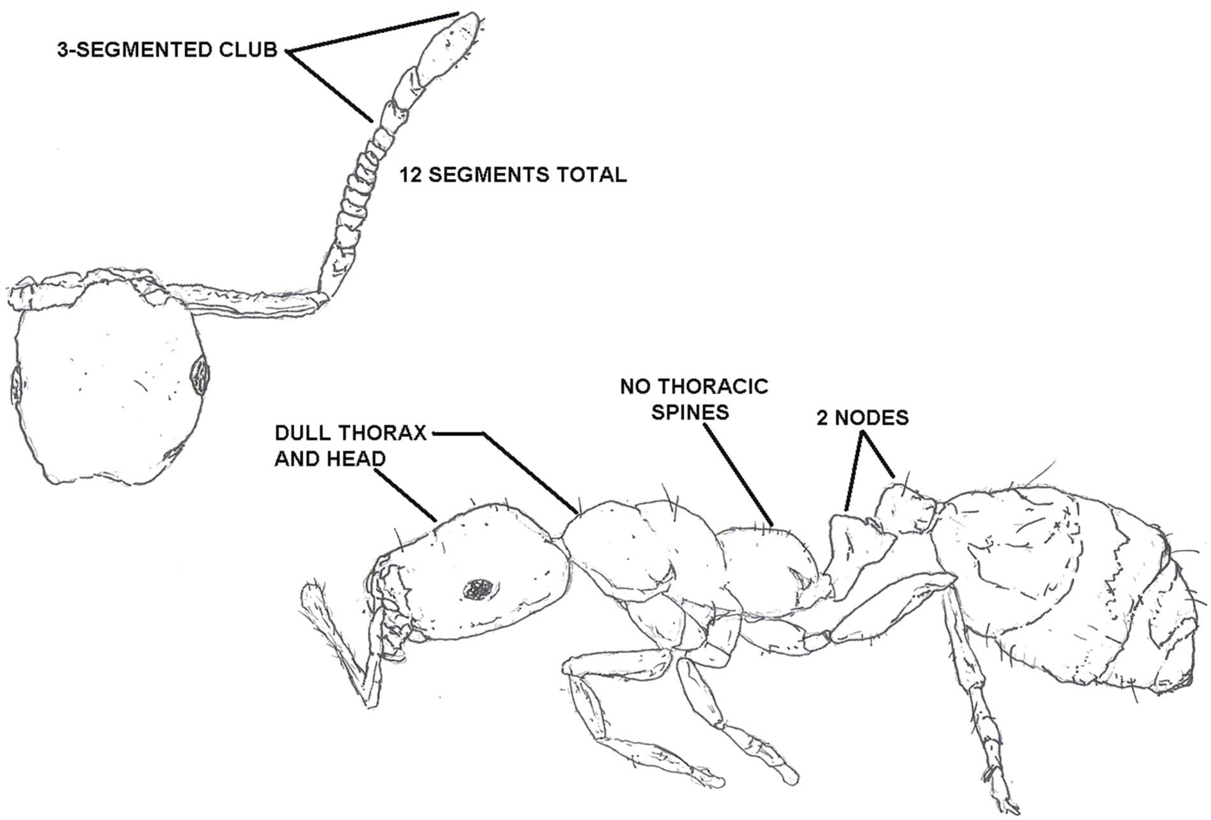


PAVEMENT ANT

(Pheidole spp.)

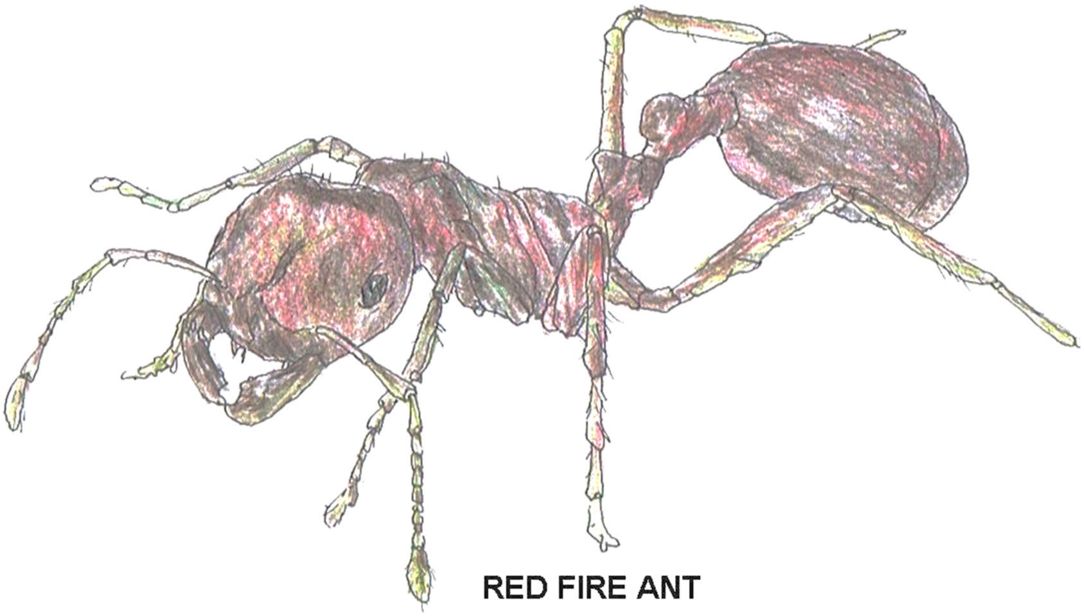
Pavement ant (Tetramorium caespitum)
Food: sweets, proteins, grease. **Nest**: in lawns or under stones, boards; build mounds along sidewalks, foundations, and near water. 3/16 inch, dark brown to black.





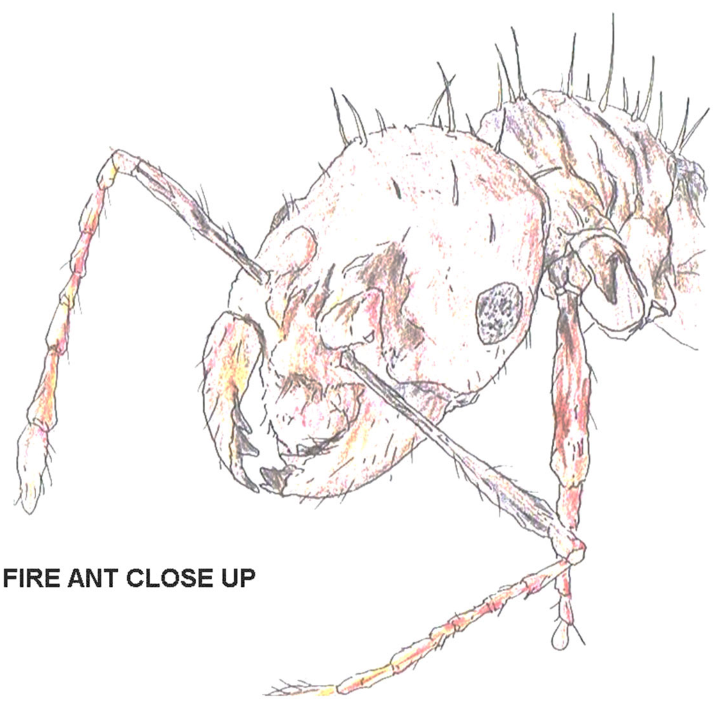
PHARAOH ANT DIAGRAM

Pharaoh ant (Monomorium pharaonis)
Food: fats, proteins, sweets. **Nest**: in wall or cabinet voids, behind baseboards, or insulation or outdoors in debris. 1/16 inch, yellow or honey colored to orange.



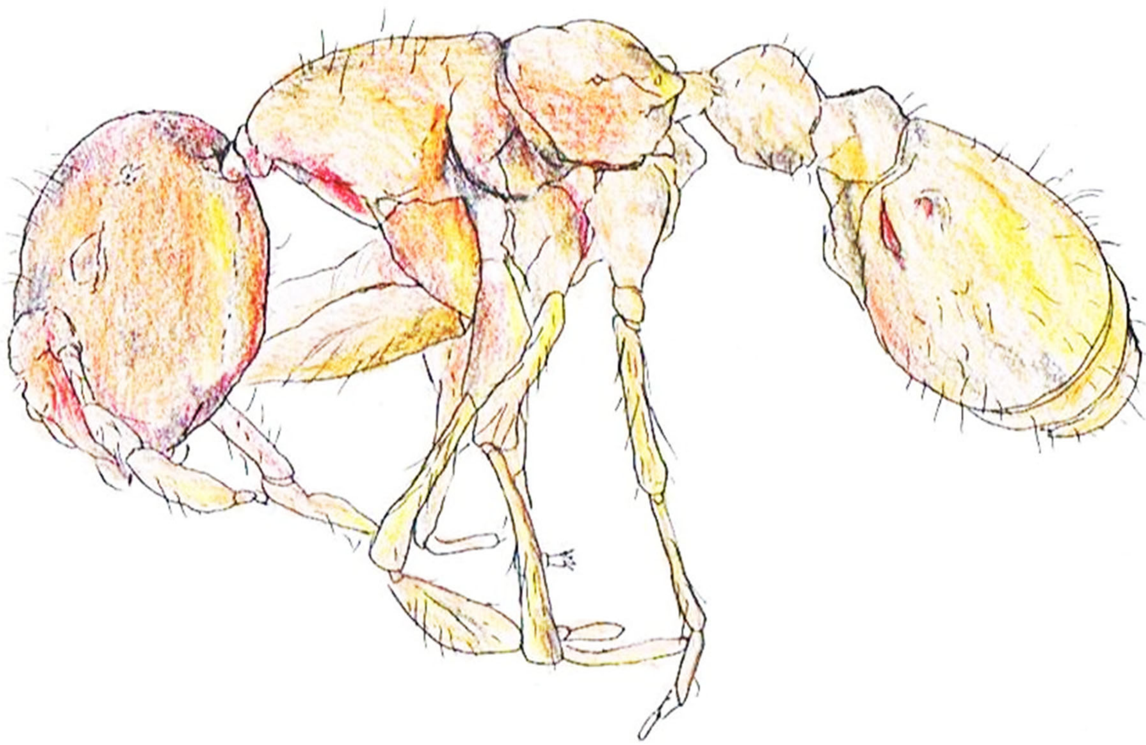
RED FIRE ANT

Red imported fire ant (Solenopsis invicta)
Food: sweets, proteins. **Nest**: in mounds with multiple openings in soil or lawns and sometimes in buildings behind wall voids. 1/16 to 1/5 inch, reddish with dark brown abdomen

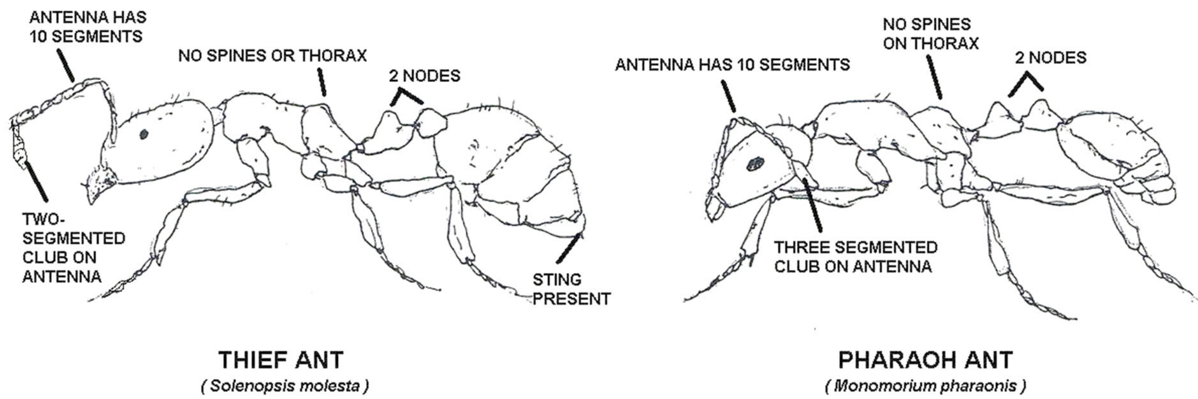


FIRE ANT CLOSE UP

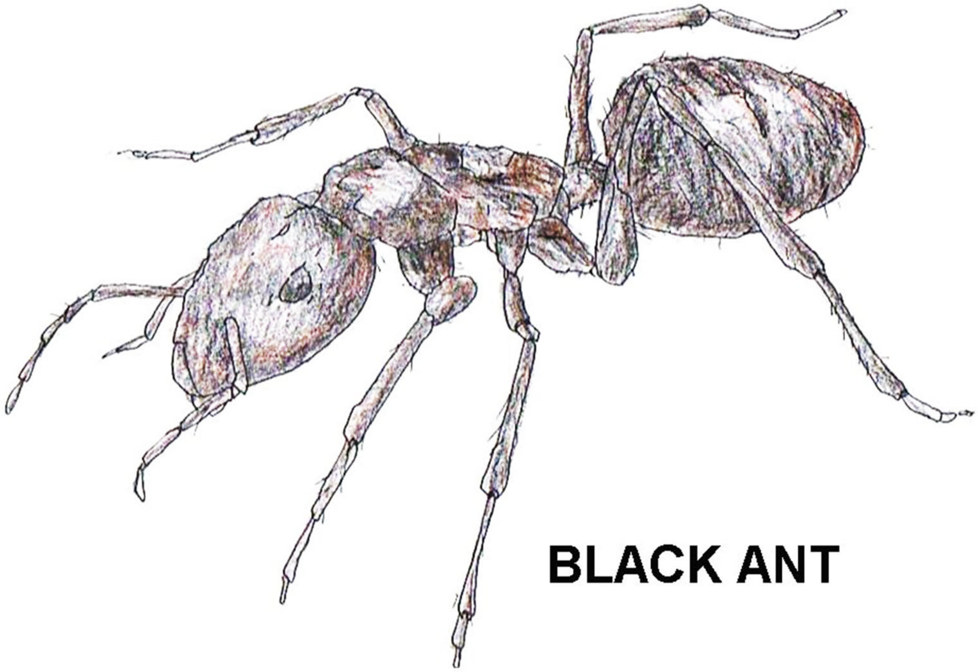
Southern fire ant (Solenopsis xyloni)
Food: proteins and sweets. **Nest**: in small mounds with flattened irregular craters in wood, under rocks. 1/8 to 1/4 inch, amber head and thorax with black abdomen, body covered with golden hairs.



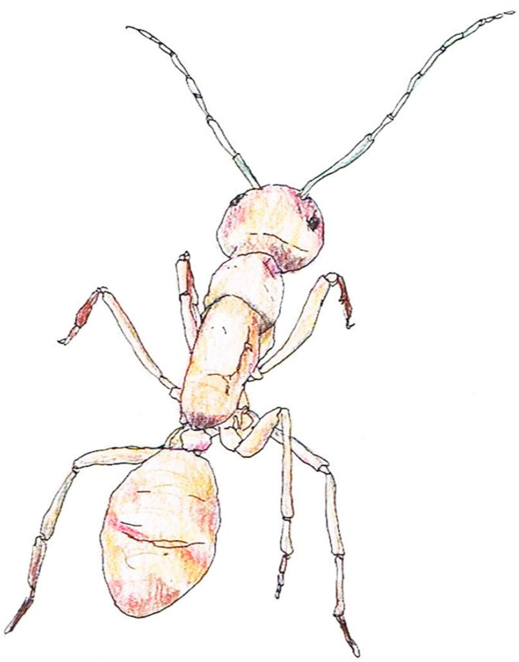
THIEF ANT DIAGRAM



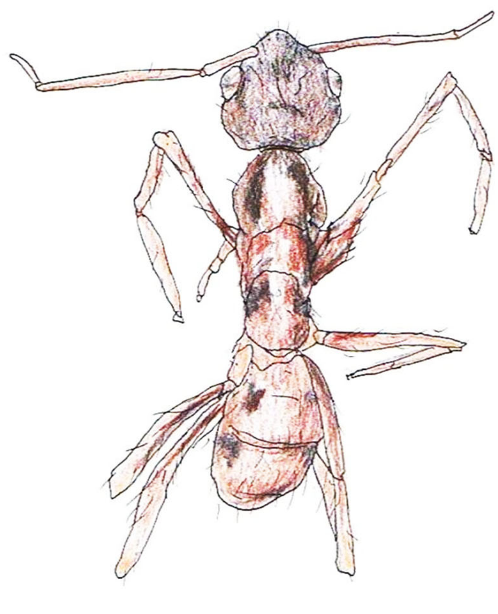
Thief Ant (Solenopsis molesta)
Food: greasy and fatty foods, sometimes sweets. Steal food and ant larvae from other ant nests.
Nest: outdoors in soil, under rocks or decaying wood or indoors behind wallboards or baseboards.
1/32 inch, yellow to light brown



BLACK ANT

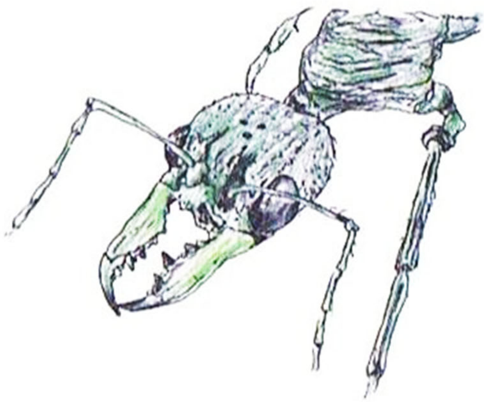


YELLOW ANT



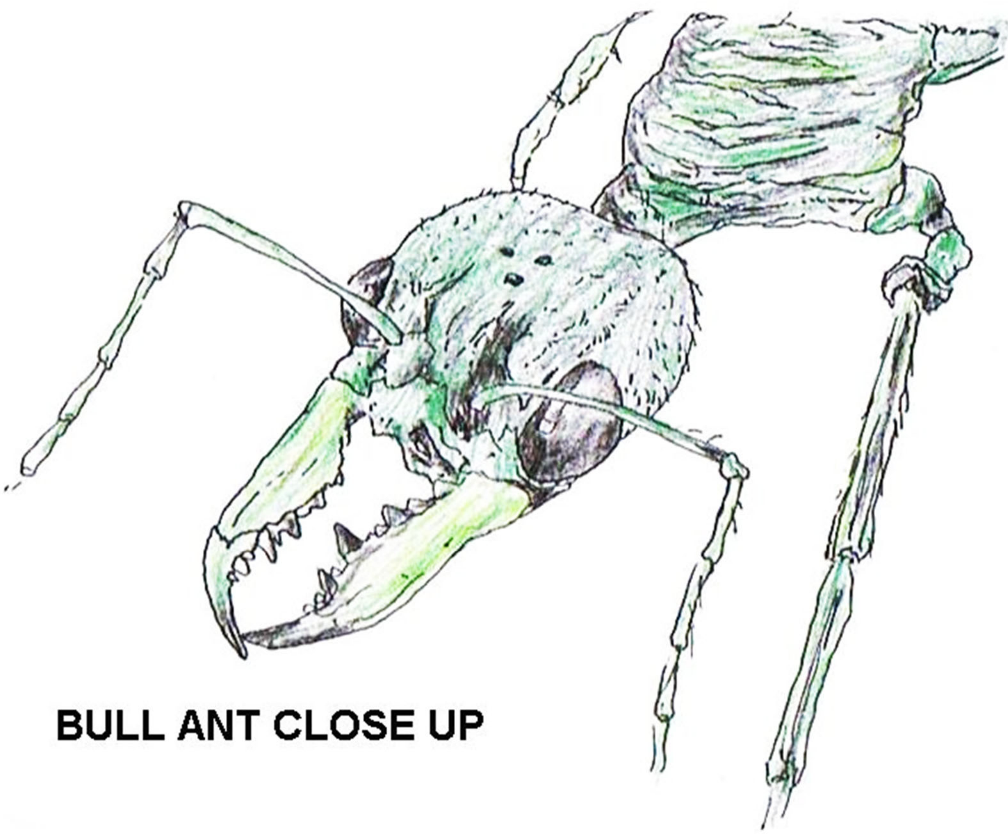
CRAZY ANT

FIRE ANT

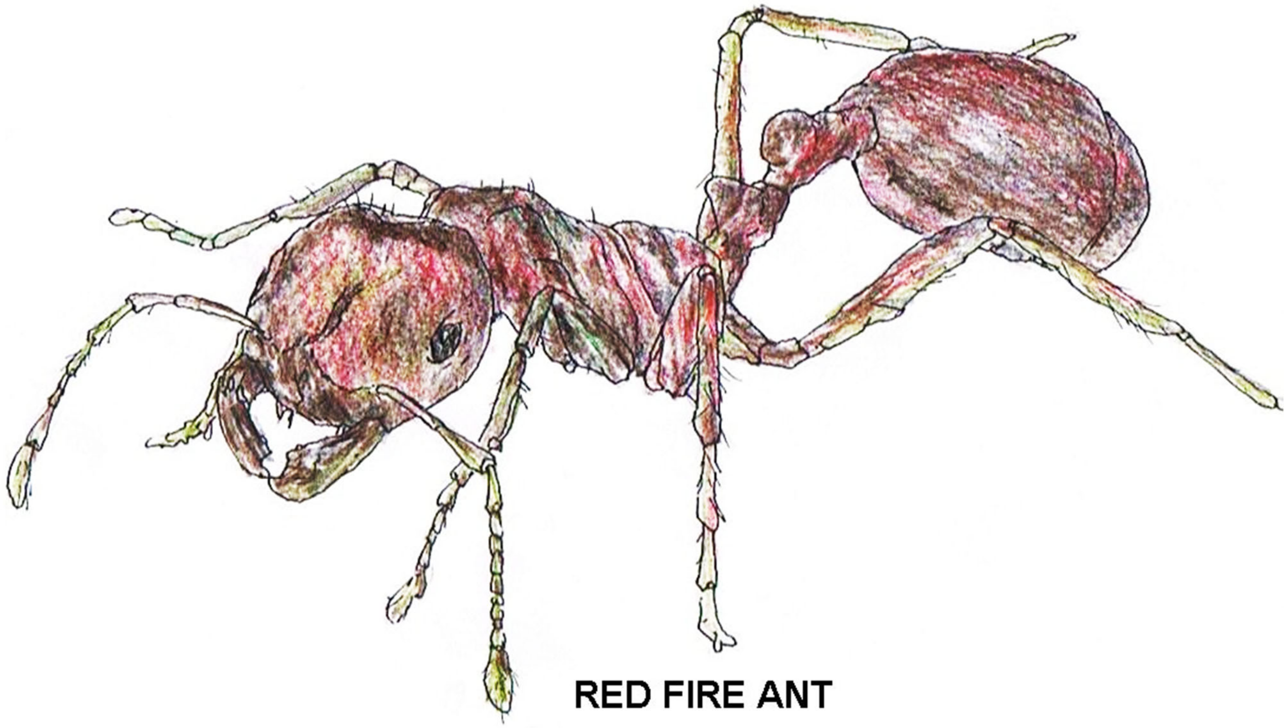


BULL ANT

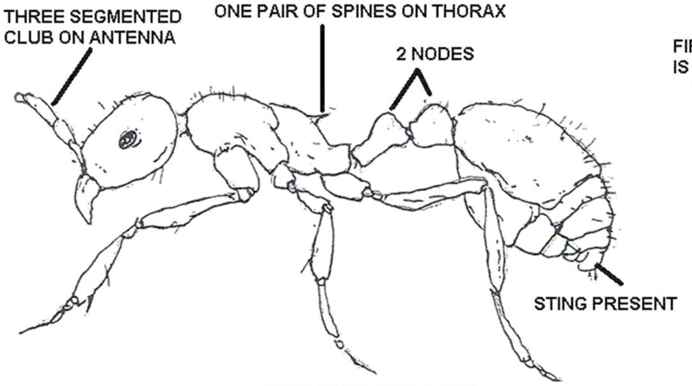
CLOSE-UP COMPARISON OF THE FIRE AND BULL ANT



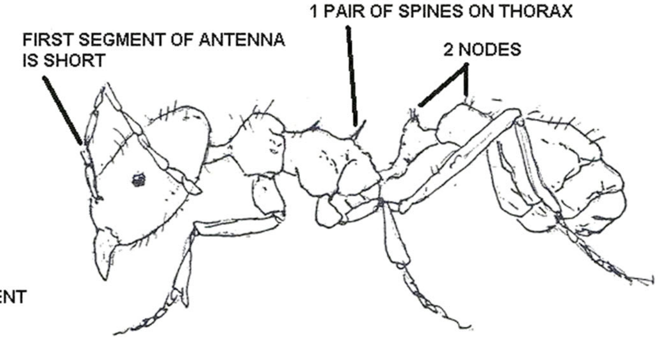
BULL ANT CLOSE UP



RED FIRE ANT

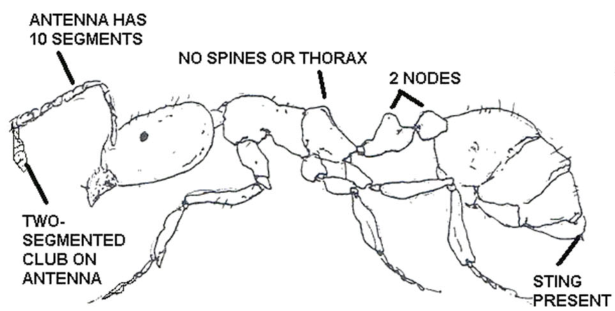


PAVEMENT ANT
(Pheidole spp.)

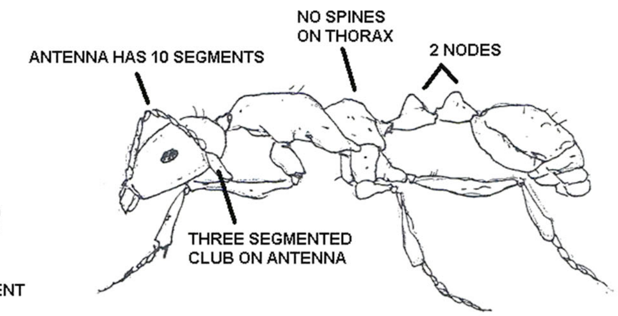


BIG-HEADED ANT
(Pheidole spp.)

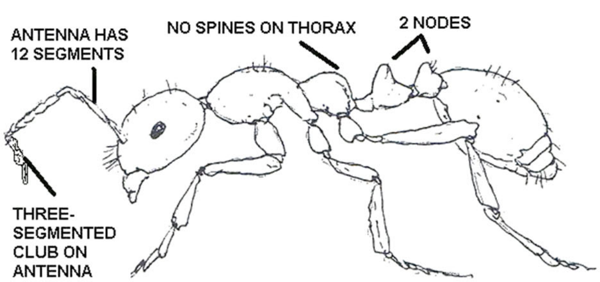
ANT IDENTIFICATION
(2-NODE ANTS)



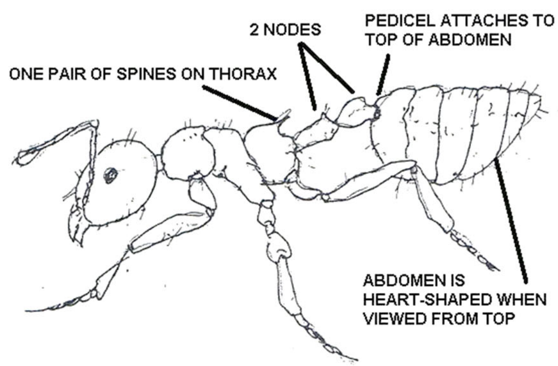
THIEF ANT
(Solenopsis molesta)



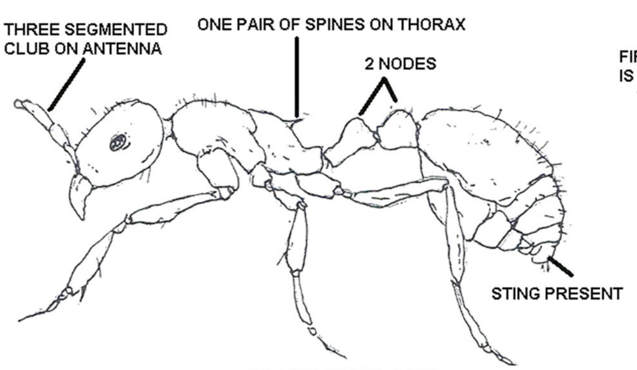
PHARAOH ANT
(Monomorium pharaonis)



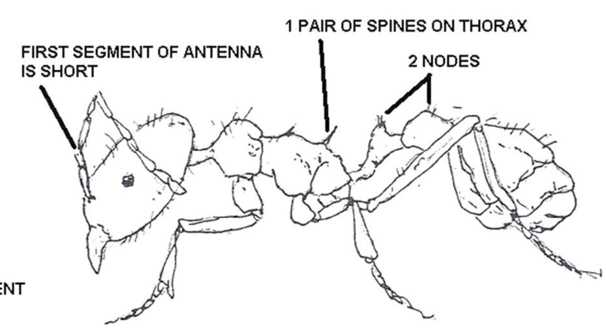
LITTLE BLACK ANT
(Monomorium minimum)



ACROBAT ANT
(Cremastogaster lineolata)

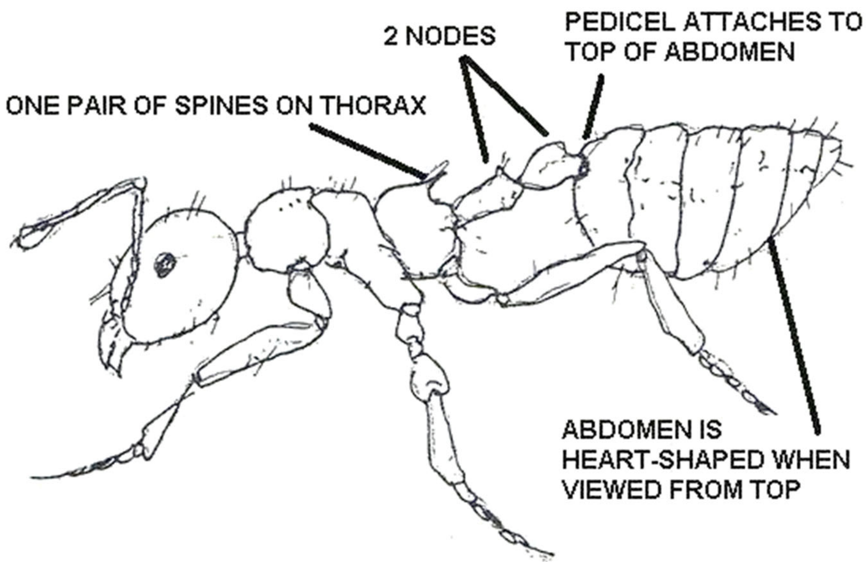


PAVEMENT ANT
(Pheidole spp.)



BIG-HEADED ANT
(Pheidole spp.)

Acrobat Ant – 2 Node Ant



ACROBAT ANT

(Cremastogaster lineolata)

Acrobat Ants, Crematogaster species (Hymenoptera: Formicidae)
Acrobat ants get their common name from their habit of raising their abdomen over their head and thorax. The workers are known to bite aggressively and to give off a repulsive odor when alarmed. In nature, colonies may nest in exposed soil, under stones, stumps and old trees. They occasionally become pests by invading homes where they are known to nest in woodwork and foam insulation, and infest household foods. They feed on live and dead insects, and they tend aphids for their sugary excrement known as "honeydew." In homes, they show a slight preference for sweets and meats or other high protein foods.

The Acrobat Ant, Crematogaster sp., nests under stones, in stumps, or dead wood, and occasionally invades the home. These ants have a heart-shaped abdomen that is often held up over their bodies. They feed primarily on honeydew produced by aphids. Acrobat ants get their name from their unique habit of sometimes running while holding their abdomen above their thorax when disturbed. This gives them the appearance of an acrobat who walks on his or her hands.

These ants do not build large, above ground mounds. Instead, they are more likely to be found nesting in dead tree limbs, hollow logs, fallen trees, old tree stumps, or even the hollow cavity of a tree. Around a home or business, acrobat ant colonies can be found in any organic litter or mulch and beneath stacks of firewood, under stepping stones, landscape timbers, bird baths, etc. They are often found in shrubs or ornamentals, feeding on insects and the honeydew produced by aphids. All of these areas must be taken into consideration when eliminating acrobat ant infestations. Worker ants enter a homes or other structure by crawling along electrical and phone lines. They also access homes from shrubs or trees that are too close to or touching the building or by simply crawling up the outside walls to enter around windows, doors, cracks, crevices, or through vents. It would be very difficult (if not impossible) to eliminate all access points.

Like all ants, the acrobat ants may produce winged, reproductive individuals (males and females) called swarmers. These sexually developed adults emerge from an established colony, usually in the fall, to disperse and start new colonies. The swarmers are harmless, but they may be the first indication of an infestation. Special treatment of swarmers beyond vacuuming or sweeping them up is not required.

Acrobat ants entering from outdoors can be managed by sealing the exterior cracks through which they enter, using a residual insecticide barrier along the foundation, or by treating the ant nest if the location can be determined through careful inspection and observation. Ant colonies living within the walls should be treated by eliminating any moisture problems (if present) and by injecting household insecticide spray or dust into infested wall voids. It may be necessary to drill small holes to accomplish this treatment. Insecticides containing pyrethroids are available to homeowners for outdoor use. Always follow labeled directs. Please read "Insecticides in the Home Landscape and Garden" for more information. Insecticides for use indoors are in ready-to-use formulations. Visit your local retailer to find a ready-to-use insecticide labeled for ants. Read and follow the directions on the label.

Detailed Description: 2.4 mm (1/10 in) (P. megacephala minors) and 3.8 mm (1/7 in) (P. megacephala majors) long. Front half of head sculptured, back half-smooth and shiny. Two-segmented petiole, where postpetiolar node is distinctly broader than long and subangular on each side. Twelve-segmented antennae with three-segmented club. Epinotal spines on propodeum. There are some 15 Pheidole species in Florida. The bilobed head of P. megacephala majors is characteristic. Subfamily Myrmicinae.

Diet: Living and dead insects. Collect honeydew from sap-sucking insects. Forage for sweets, fats, and proteins in homes.

Most Common Complaints: Foragers both inside and outside. Piles of sand and other debris indoors. Outdoor colonies are difficult to control because of multiple nests, so restrict access to buildings. Management includes locating and appropriately treating colonies. Treating using outdoor granular baits may be used, but may not be effective when large colonies are present.

Insecticides
In areas of active colonies, treat walls and ceiling voids through cracks and crevices with non-repellent boric acid dust and make bait placements. Keep the ants in the area long enough to get the slow-acting toxicants to the main colony where the workers, larvae and queens are poisoned. (A delayed-action stomach poison is recommended.) Repellent insecticides, such as pyrethrins, will move the colonies, spreading them further throughout the building.

Research has shown that it is best to use bait placement only where active ant trails are found. This ensures feeding, since some ants have not been able to find the bait even when only one inch away from the bait stations. Intersect the ant trail with bait on a cotton swab taken from the station to ensure instant feeding.

Bait preference may change during the season due to changing needs of the developing colonies. An effective bait is a 99 percent boric acid formulation mixed at a 5 percent concentration by weight in mint apple jelly (about two level tablespoons of powdered boric acid per 10 ounces of mint apple jelly). Another bait is 2 percent boric acid and 98 percent light corn syrup.

Methoprene
A commercial bait called methoprene (Pharorid) is marketed for use by pest control operators in a bait that consists of liver, honey, and sponge cake. It is often difficult to use the bait ants prefer; as ants feed on one compound, another compound placed less than 1/4-inch away will be ignored until the ants spill over into the second bait.

Boric Acid
Boric acid and methoprene baits work slowly, sometimes taking 15 to 40 weeks or more before ant eradication. A bait containing hydramethylon (same as in Maxforce roach bait stations) gives quicker results, 2 to 35 days, according to certain pest control operators. Bait stations may include jumbo size plastic drinking straw sections, medicine (pill) dispensing cups, plastic vial caps and/or drafting (masking) tape. Placement can be made on the rear lip of kitchen counters, at plumbing pipe-wall junctions, on window sills, behind wall electrical outlets, above door frames, etc., in less accessible areas of pets or young children.

There may be increased or new ant feeding activity during the early part of the baiting program. No other pesticides, heavy-duty cleaners, or paints should be used during the baiting periods to discourage ant feeding.

Bendiocarb
Applications of bendiocarb (Ficam), which is odorless, can give fast eradication of ants if treatments are thorough. Ficam 76 percent WP and 91 percent dust is labeled for licensed commercial and pest control operators. The bait products most recommended for Pharaoh ant control include: (boric acid plus mint apple jelly (Drax), hydramethylnon (Maxforce), methoprene (Pharorid), bendiocarb (Ficam), propoxur (Baygon) and sulfluramid (Pro-Control)).

After bait stations are placed, one will see ants trailing to and from these bait stations. Do not spray or disturb the ants or bait stations. Ants must be allowed to carry the bait back into their nest where the active ingredient in the bait will eliminate the colony.

Detergent Barrier
Temporary "moats" of detergent and water may be useful during heavy ant invasions.
- Containers of food or food waste which must remain open during working hours can be placed in large, shallow pans filled with water mixed with a small amount of detergent.
- Use this technique to protect potted plants from ants that may be attracted to nectar produced by the plant or to honeydew produced by plant-feeding insects. Elevate the pot above the detergent-and-water mixture by placing it on an overturned saucer. Make sure the limbs and leaves of the plant are not in contact with surfaces that ants could use as bridges.

Chemical Controls
At times, non-chemical methods alone prove insufficient to solve the problem. Integrating a pesticide into your management program may be necessary to gain control of the ant problem. Pesticides must be used in accordance with their EPA-approved label directions.

Applicators must be certified to apply pesticides and should always wear protective equipment during applications. All labels and Safety Data Sheets (SDS) for the pesticide products authorized for use in the IPM program should be maintained on file. Do not apply these materials when buildings are occupied, and never apply them where they might wash into drains or sewers. When treating ants, all baits and dusts should be placed in cracks, crevices, and in precise areas where ants are active.

Detergent and Water
When ants invade a classroom or food preparation area, use a mixture of soap and water in a spray bottle. This mixture will quickly kill the ants which can then be wiped up with a sponge and washed down the drain. Each classroom, cafeteria, and food preparation area should be equipped with such a spray bottle so teachers and staff can safely deal with emergencies.

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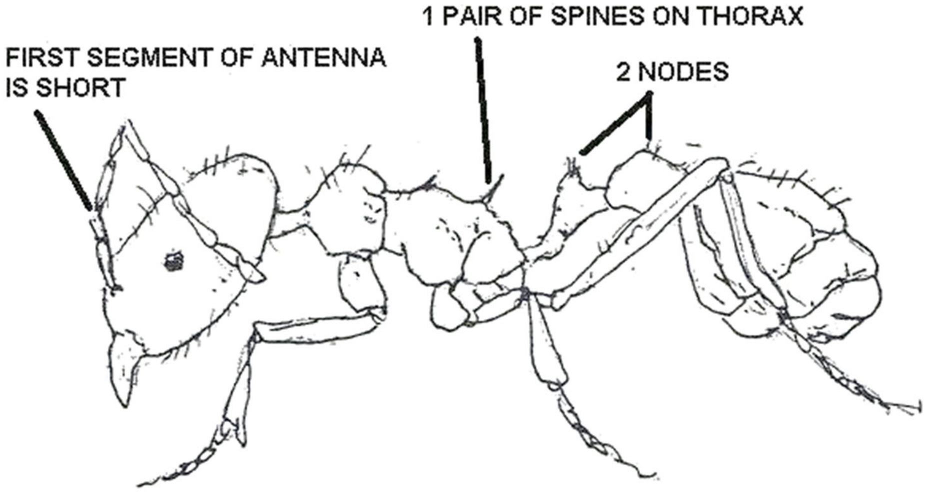
Bigheaded Ant – 2 Nodes



BIG-HEADED ANT
(Pheidole spp.)

The **Bigheaded Ant**, *Pheidole megacephala* (Fabricius). Worker ants have relatively large heads compared to their bodies. They have a 12- segmented antenna and 3-segmented clubs. Their habits are similar to red imported fire ants, feeding on live and dead insects, seeds, and honeydew outdoors, and greasy food sources and sweets indoors.

Foraging Characteristics: Small, light brown to reddish brown to nearly black, dull ants. Often foraging in columns. Two worker sizes, although the major (larger, soldier worker) is rare. Majors may appear near baits. Major’s head is disproportionately larger than body. No workers intermediate in size will be found. Slow moving. Nest Sites & Characteristics: Nest in soil or under stones, logs, wood, or debris. P. megacephala foraging trails are sometimes soil-covered and resemble subterranean termite foraging tubes. Multiple queens. P. megacephala colonies can be spread out into megacolonies.

Habits
Big-headed ants are most common in warmer areas of the United States. This ant primarily lives outdoors and only occasionally invades structures.

Colonies have multiple queens and can be very large. Nesting is usually in the soil in protected locations like under rocks, logs, firewood, patio blocks, landscape timbers and more. The ants will also nest in open areas. Big-headed ants will construct mud tubes on foundations, similar to termite tunnels.

Detergent Barrier
Temporary "moats" of detergent and water may be useful during heavy ant invasions.

- Containers of food or food waste which must remain open during working hours can be placed in large, shallow pans filled with water mixed with a small amount of detergent.
- Use this technique to protect potted plants from ants that may be attracted to nectar produced by the plant or to honeydew produced by plant-feeding insects. Elevate the pot above the detergent-and-water mixture by placing it on an overturned saucer. Make sure the limbs and leaves of the plant are not in contact with surfaces that ants could use as bridges.

Chemical Controls

At times, non-chemical methods alone prove insufficient to solve the problem. Integrating a pesticide into your management program may be necessary to gain control of the ant problem. Pesticides must be used in accordance with their EPA-approved label directions. Applicators must be certified to apply pesticides and should always wear protective equipment during applications. All labels and Material Safety Data Sheets (MSDS) for the pesticide products authorized for use in the IPM program should be maintained on file. Do not apply these materials when buildings are occupied, and never apply them where they might wash into drains or sewers. When treating ants, all baits and dusts should be placed in cracks, crevices, and in precise areas where ants are active.

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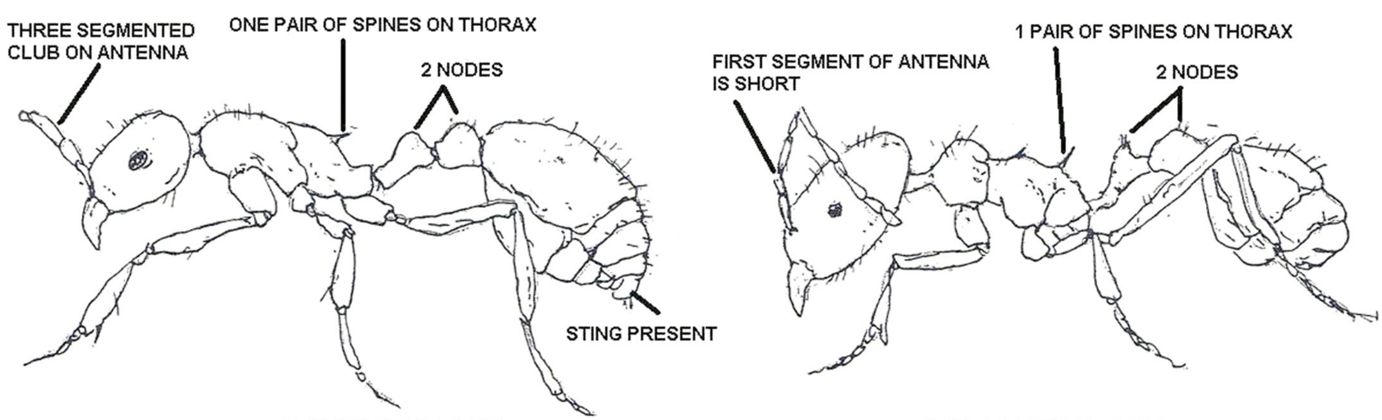
Insecticides

In areas of active colonies, treat walls and ceiling voids through cracks and crevices with non-repellent boric acid dust and make bait placements. Keep the ants in the area long enough to get the slow-acting toxicants to the main colony where the workers, larvae and queens are poisoned. (A delayed-action stomach poison is recommended.) Repellent insecticides, such as pyrethrins, will move the colonies, spreading them further throughout the building.

Research has shown that it is best to use bait placement only where active ant trails are found. This ensures feeding, since some ants have not been able to find the bait even when only one inch away from the bait stations. Intersect the ant trail with bait on a cotton swab taken from the station to ensure instant feeding. Bait preference may change during the season due to changing needs of the developing colonies.

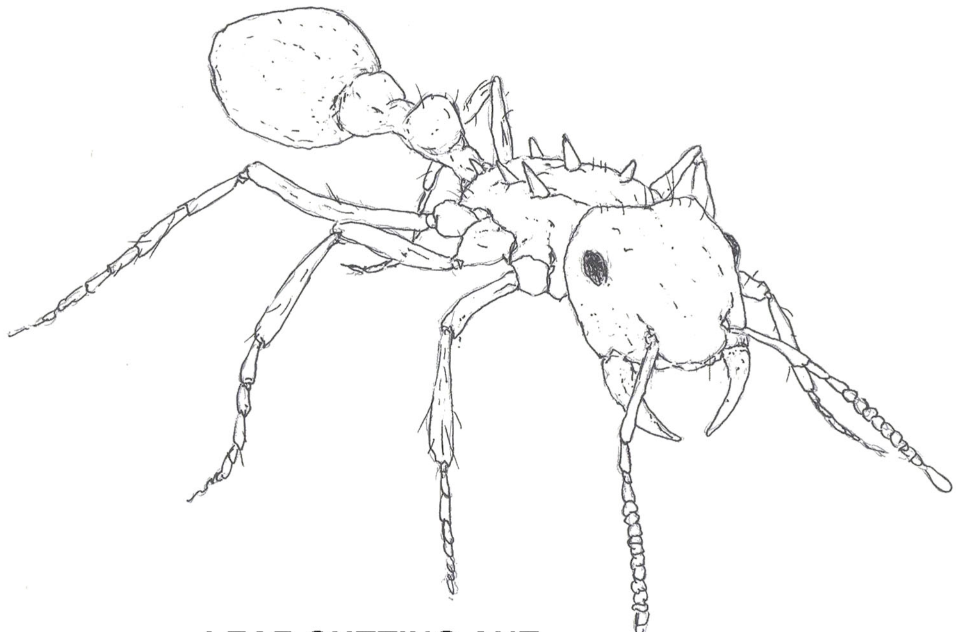
An effective bait is a 99 percent boric acid formulation mixed at a 5 percent concentration by weight in mint apple jelly (about two level tablespoons of powdered boric acid per 10 ounces of mint apple jelly). Another bait is 2 percent boric acid and 98 percent light corn syrup.



PAVEMENT ANT
(Pheidole spp.)

BIG-HEADED ANT
(Pheidole spp.)

Leaf Cutter Ants *Atta texana*– 2 Node Ant



LEAF-CUTTING ANT

Leafcutter ants, a non-generic name, are any of 47 species of leaf-chewing ants belonging to the two genera *Atta* and *Acromyrmex*. These species of tropical, fungus-growing ants are all endemic to South and Central America and parts of the southern United States.

The *Acromyrmex* and *Atta* ants have much in common anatomically; however, the two can be identified by their external differences. *Atta* ants have three pairs of spines and a smooth exoskeleton on the upper surface of the thorax, while *Acromyrmex* ants have four pairs and a rough exoskeleton.

Next to humans, leafcutter ants form the largest and most complex animal societies on Earth. In a few years, the central mound of their underground nests can grow to more than 98 ft. across, with smaller, radiating mounds extending out to a radius of 260 ft., taking up 320 to 6,500 sq. ft. and containing eight million individuals.

Appearance
The worker ants range in size from 1/16"-to 1/2 ". They are red, with two nodes. The winged reproductives or swarmers produced by the leaf cutter ant colonies are quite big. The females are well over 2 inches long. The males are much smaller. They are rusty brown. A relatively large ant with a spiny body and long legs.

Leaf cutter ants are mounded ants; like fire ants, they establish a mound outside. Found mainly in the United States in south central and eastern Texas and into parts of western Louisiana, they are also called "*cut ants*" or "*parasol ants*." Leaf cutter ants are mainly a rural, agriculture pest, but can be found in subdivisions. Leaf cutter ants usually come to your attention when plants, trees or shrubs are being stripped of their leaves. The usually select one type of plant to feed off, ignoring others.

Leaf-cutter ants are major agricultural pests in Central and South America. It has been estimated they do $1 billion damage per year in crop losses in North and South America.

Although primarily an agricultural pest, this insect on occasion may invade the home for cereals. In the United States, the Texas leaf-cutting ant occurs in Texas and Louisiana. This ant is believed to cause a total yearly loss of $5 million in the United States.

Inspection
Sometimes, they enter structures, but don't stay long. Look for nest sites that have high moisture, such as creek beds, drainage ditches, and streams. Sometimes you can discover their nest by following the foraging ants' home. A nest will have many entrances with craters of loose soil that have been deposited above. During the summer, workers forage during the night. They will forage in the daytime during the spring and fall, unless it is rainy or overcast. A "*trail*" of leaves can lead you to a nest, as well. Try to discover the entrances to the nest for possible treatment. The swarmers often swarm in the night during the months of April or May. They are attracted to lights on buildings and can be found crawling, in large quantities, on buildings, following a major swarm. They cause no real damage.

Diet
Using their scissor-like jaws, they completely strip trees and other plants of their foliage, carrying back the leaves to their vast underground nests, where millions of ants live. It is in these chambers that leaf-cutters do something very unusual with the leaves that they bring back to the nest.

The leaves are not eaten; they are chewed into a pulp-like material, which soon sprouts a fungus. This special, mushroom-like fungus serves as the colony's only food. Being very selective about the species of leaves they collect causes these ants to travel several hundred yards on leaf-gathering foraging. The ants leave an invisible scent on the trails they use in order to find their way home.

Nests
The nest may cover 3,000 to 4,500 square feet and may be 8 feet or more deep. A nest has many chambers containing fungus, perhaps two to three dozen, and many dozens of entrances. In addition, the nests of some species of leaf cutter ants may contain 1,000,000 or more workers. Their queens are among the largest of ants.

Beneficial Insects
Leaf-cutter ants help maintain the health of the environment. The by-products from the leaves, fungi, and ant wastes fertilize the soil.

Recommended Products and Treatments
It is recommended that you drench the mounds with a weakened diluted residual insecticide; such as *Conquer*. However, the nest may be deep, and often located near bodies of water, so if in doubt, call your local extension agency for their recommendations.

Methoprene
A commercial bait called methoprene (Pharorid) is marketed for use by pest control operators in a bait that consists of liver, honey, and sponge cake. It is often difficult to use the bait ants prefer; as ants feed on one compound, another compound placed less than 1/4-inch away will be ignored until the ants spill over into the second bait. These recommendations are provided only as a guide. It is always the pesticide applicator's responsibility, by law, to read and follow all current label directions for the specific pesticide being used. Due to constantly changing labels and product registration, some of the recommendations given in this writing may no longer be legal by the time you read them. If any information in these recommendations disagrees with the label, the recommendation must be disregarded.

Little Black Ant

Little Black Ant
The scientific name of the little black ant is *monomorium minimum*. Little black ants are small and dark brown, black or jet-black in color. Little black ants are a native species found throughout the United States, with concentrations in thought-out areas of the US. Worker little black ants can be as small as one millimeter in length, and queens can measure up to four millimeters. Their antennae consist of twelve segments and end in a three-segmented club. Their pedicel is two-segmented. Little black ants have no spines and their bodies are unevenly rounded. Although little black ants bear a stinger, it is too small to be effective against most threats. Both males and queens have wings before mating season, though males die soon after mating and females shed their wings. Little black ants prefer meat, but they are omnivorous and will eat insects, sweets, honeydew, vegetables, grease or oily foods, corn meals and plant secretions as well. Little black ant workers forage in trails, which are frequently seen along sidewalks and foundation walls.

Proverbs 6:6-8

A Lesson from the Ant
6-11 You lazy fool, look at an ant. Watch it closely; let it teach you a thing or two. Nobody has to tell it what to do. All summer it stores up food; at harvest it stockpiles provisions.

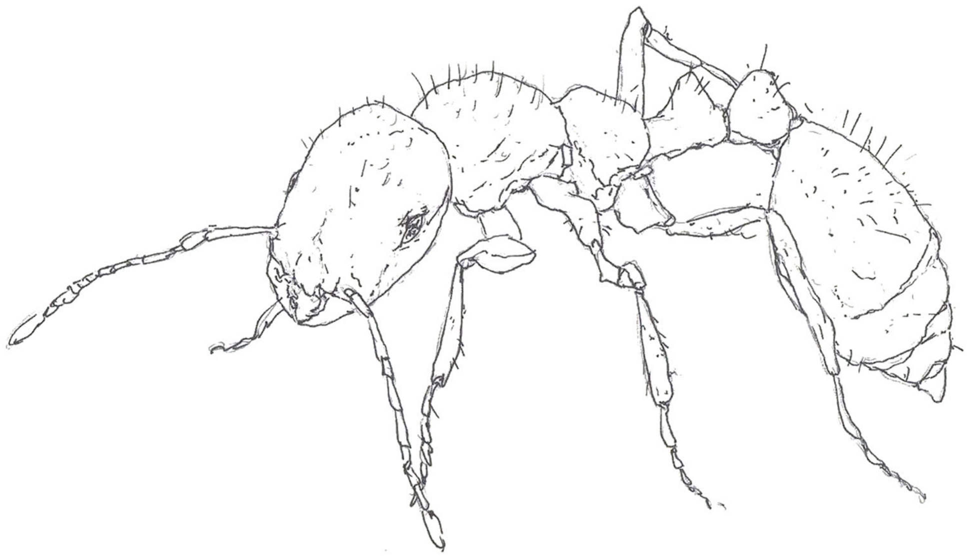
So how long are you going to laze around doing nothing?

How long before you get out of bed?

A nap here, a nap there, a day off here, a day off there, sit back, take it easy—do you know what comes next? Just this: You can look forward to a dirt-poor life, poverty your permanent houseguest!

These little black ants are awesome workers. These ants carried a small lizard twenty feet to their nest within 1 hour. They worked together and overcame all obstacles. One obstacle was carrying the lizard over gravel. Ants waited and gathered more workers and carried the lizard to the nest. They did not bite or tear the flesh but kept the body together. Incredible work effort!

Little Black Ant Identification and Control – 2 Node Ant
Monomorium minimum



LITTLE BLACK ANT

Black Ant
The little Black Ant, *Monomorium minimum*, is a slow-moving, small black ant that is generally not a pest indoors. Workers prey on insects and feed on honeydew produced by sucking-types of insects, such as aphids. The little black ant is versatile, nesting both indoors and outdoors. The ants prefer decayed woods, but will build nests in any woodwork voids or cracks in cement. Outdoor colonies are found under stones/rocks, in rotting logs, in lawns, or in open areas. Nests can be located by the small craters of fine soil which are deposited at their entrances.

Foraging and Feeding of the Black Ant
The workers forage in scent marked trails along the edges of structures such as foundation walls and along sidewalks outside. They feed on aphids as a source of honeydew, plant secretions and are predaceous on other insects. In the home the little black ant will feed on almost any food items it can find, such as grease, oil, meats, sweets, fruits and vegetable materials such as corn meal. The little black is native to the United States and can be found throughout the country. They are most populous in the eastern half of the U.S., in southern California, and in the bay area of San Francisco.

The Little Black Ant is found throughout the US especially the Eastern half of the US and southern California. They get their name from their size and jet black color. The workers are only 1/16 of an inch and the queen is twice that size at 1/8 of an inch. They have a 12 segment antenna with a 3 segmented-club. Little Black Ants have 2 nodes and a small weak stinger.

Swarmers are usually found from June to August when mating and new colonies are formed. The colonies have multiple queens which aids the colonies to grow rapidly. Closely related to the Pharaoh ant in identification except the color, the Little Black Ant is also often mistaken for another ant pest: the Rover Ant.

The Little Black Ant (Monomorium minimum) is a species of ant. Members of the species are tiny and shiny black in color. These ants are pests that are usually found outdoors or in wood inside a home that causes it to decay. Workers are 1/16 inch in length and the queens are 1/8 inch in length. They use recruitment to deal more effectively with large prey. They form colonies with multiple queens.

Ants give birth to live pupa. Ant pupa laid by the queen can take just 10 days to mature. Winged ants may fly away and start a new colony if the current colony is overpopulated. The little black ant nests inside and outside. Outside they prefer decade wood but will also nest under rocks, lawns and also in open areas. Inside they can be found in wood work voids and cracks in cement and under edges of carpet. Their nests can be located by small caters of fine soil deposited at the entrance. Colonies are very mobile and are willing to move if disturbed.

When foraging, little black ants leave a scent mark trail along the edges of structures such as walls, sidewalks or baseboards. These trails can be followed to the nest for baiting or trenching the mounds. The ants will feed on honeydew, grease, oil, meats, fruits, vegetables and sweets. Indoor ant infestations are not typically the result of indoor colonies.

Usually the ants are nesting outside and coming in to the house or building to forage for food. In that case, drenching the exterior mounds with an insecticide such as Cypermethrin can often be the most important step in achieving control.

When mounds cannot be located, spraying the window seals and cracks with Cypermethrin (Cynoff EC, Cynoff WP, Demon WP or Demon WP) and using a sweet bait or dual bait such as Gourmet or Advance Dual Choice in the house is a great combination. NEVER use an indoor spray if you are incorporating the use of an indoor ant bait! Such tactics will usually contaminate your bait, resulting in failure to control the pests.

Simply picking up rocks and debris around the house will also help. If the ants are nesting in the house, the wall voids will need to be dusted with Drione in areas where ant baits are not to be used. Ant infestation are not easy to control and different strategies should be used depending on nest location and food preferences of the ants. Ants can be controlled with a combination of good sanitation, removing pheromone trails, caulking entry points and eliminating active nests. Insecticide sprays and baits can be used to kill foraging ants and destroy nests, but strategies designed to prevent further infestations should be used in conjunction with chemical treatment.

In general, ant baits can be found as:

- Granules for broadcast
- Liquids
- Gels
- Ready-to-use, tamper resistant containers

Perimeter Insecticide Treatments

The most commonly used method for controlling carpenter ants is treating the perimeter of a home with a dust or spray. There are several products available for this type of application, but Suspend SC, Talstar Concentrate and Cynoff WP are the best. When used in accordance with their labels they work well. However, these treatments do not keep ants from entering a home from overhead trees and power lines. Also, as a stand-alone treatment, they rarely eliminate ants inside voids and walls.

Recommended Products and Treatment
Baiting is the preferred treatment over typical residual spraying, to eliminate the entire colony. The use of residual sprays or dusts will cause stress on the colonies, causing them to split into sub-colonies that scatter to other areas in the structure. This is also called budding. After spraying, the problem can be worse than at the beginning. When you bait, you will want a slow-acting bait.

Quick-kill insecticides and baits will only kill the foraging ants, not allowing the foraging ants to take the bait back home to feed the queen, nest workers and brood. If the current ant bait that you are using is not acceptable to the ants (if they are not visiting the bait), it is recommended that you change the baits.

Ants require carbohydrates sugars, proteins, and greases. They find a variety of these sources in nature. Examples are: other insects (proteins and greases), nectar, aphid honeydew, and plant products (sugar and carbohydrates).

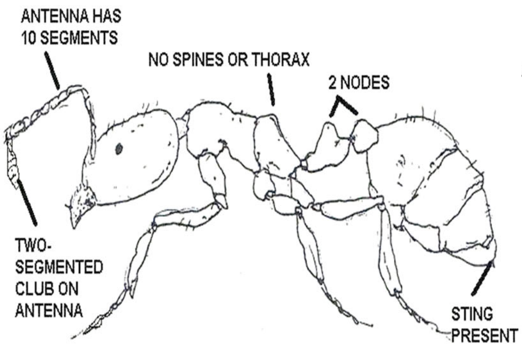
The Recommended Products for the Protein/Grease Eating Cycle Would Be:
- Maxforce Ant Bait Stations
- Flourguard Ant Bait Stations
- Maxforce Ant Granulars
- Advance Carpenter Ant Bait

The Recommended Products for the Sugar Eating Cycle Would Be:
- Maxforce Ant Killer Bait Gel
- Uncle Albert's Gel Bait
- Revenge Liquid Ant Bait
- Maxforce Granular Ant Bait is an excellent choice for the outside, feeding all their dietary needs.
- Ant bait stations such as: Ant Cafes small or large plastic cubes (that snap shut) that keep the gel or dry granulated bait inside, may serve to keep the baits intact.
- Dr. Moss Liquid Ant Bait can be applied to areas where ants are foraging. For use of Dr. Moss Liquid Ant Bait, you should use the Dr. Moss Liquid Ant Bait Station

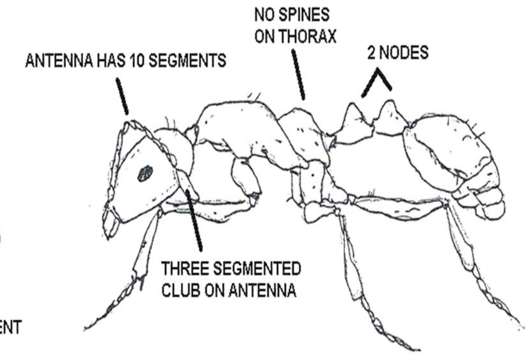
Perimeter Treatment with Good Residual Sprays Such As:
- Suspend or Demon WP can at times prevent these ants from entering the structures.

Key
The key to using baits is patience. Applied properly and using a fresh bait product, a broadcast application will give 80% to 90% control, rarely 100%. For instance, Amdro® is the fastest acting, giving maximum control in 3 to 6 weeks. Logic® or Award®, when applied late in the year, may take several months to provide maximum control, but will suppress ant colonies for a year or more.

One approach, for example, for heavy imported fire ant infestations is to treat with Amdro® first for fast knockdown, then come back with Logic®/Award® for longer duration of control as ants start to re-infest the area some months in the future. Other baits include Siege®, Award®, Ascend®, and Raid® Fire Ant Killer.

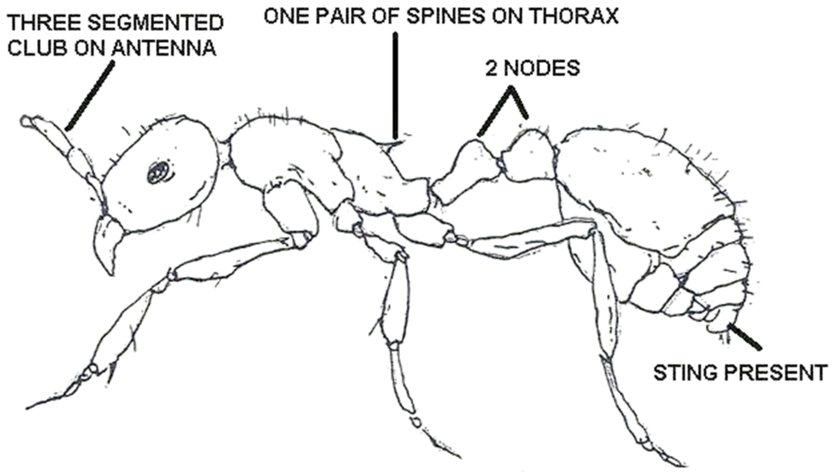


THIEF ANT
(Solenopsis molesta)



PHARAOH ANT
(Monomorium pharaonis)

Pavement Ant *Tetramorium caespitum* – 2 Node Ant



PAVEMENT ANT
(Pheidole spp.)

Workers of the Pavement Ant, *Tetramorium caespitum* (Linnaeus), also resemble the fire ant, but on close examination, the head and thorax are roughened with parallel grooves, rather than being smooth.

Control
To avoid further infestations indoors, all cracks and gaps in exterior walls should be sealed. To limit the nesting of ants surrounding the dwelling, all debris should be removed and firewood stored off the ground. Their foraging trails can be followed back from the food source to the nest. Infested interior walls and voids in the outside ground-floor walls may be treated by aerosol injection of a suitable insecticide (CB-80, CB-Invader, CB-Strikeforce) or by an application of a dust formulation (Delta Dust). Baiting, however, may also be necessary. Baits should be positioned where ant trails have been established. Sweet baits are generally the most effective; however, if acceptance is low, a protein-based bait may be considered.

Detergent Barrier
Temporary "moats" of detergent and water may be useful during heavy ant invasions.

- Containers of food or food waste which must remain open during working hours can be placed in large, shallow pans filled with water mixed with a small amount of detergent.
- Use this technique to protect potted plants from ants that may be attracted to nectar produced by the plant or to honeydew produced by plant-feeding insects. Elevate the pot above the detergent-and-water mixture by placing it on an overturned saucer. Make sure the limbs and leaves of the plant are not in contact with surfaces that ants could use as bridges.

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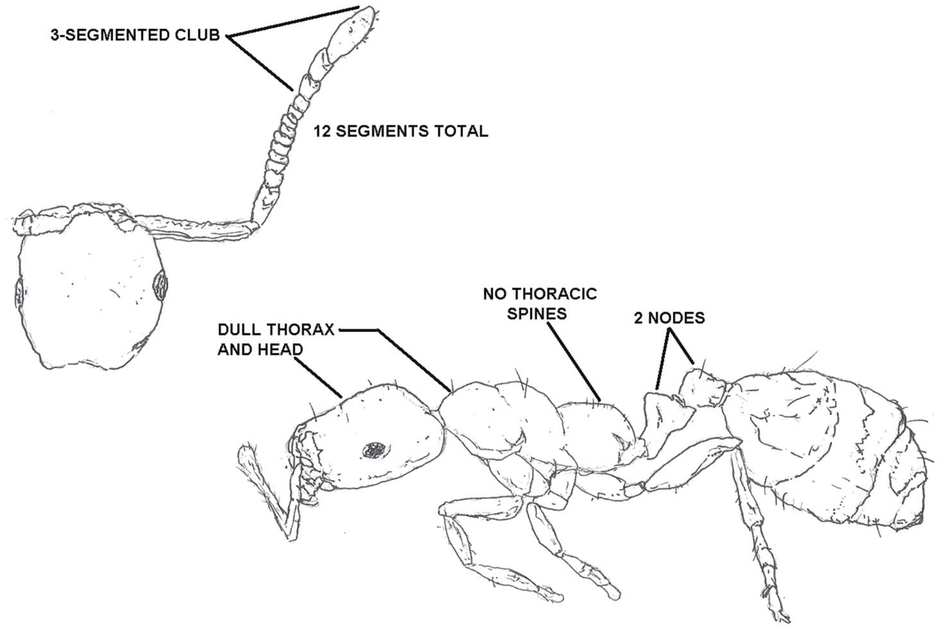
Boric Acid
Boric acid and methoprene baits work slowly, sometimes taking 15 to 40 weeks or more before ant eradication. A bait containing hydramethylon (same as in Maxforce roach bait stations) gives quicker results, 2 to 35 days, according to certain pest control operators. Bait stations may include jumbo size plastic drinking straw sections, medicine (pill) dispensing cups, plastic vial caps and/or drafting (masking) tape. Placement can be made on the rear lip of kitchen counters, at plumbing pipe-wall junctions, on window sills, behind wall electrical outlets, above door frames, etc., in less accessible areas of pets or young children. There may be increased or new ant feeding activity during the early part of the baiting program. No other pesticides, heavy-duty cleaners, or paints should be used during the baiting periods to discourage ant feeding.

Bendiocarb
Applications of bendiocarb (Ficam), which is odorless, can give fast eradication of ants if treatments are thorough. Ficam 76 percent WP and 91 percent dust is labeled for licensed commercial and pest control operators. The bait products most recommended for Pharaoh ant control include: (boric acid plus mint apple jelly (Drax), hydramethylnon (Maxforce), methoprene (Pharorid), bendiocarb (Ficam), propoxur (Baygon) and sulfluramid (Pro-Control)).

Pharaoh Ant ***Monomorium pharaonis*** **– 2 Node Ant**



PHARAOH ANT

Order: Hymenoptera

Identification
Pharaoh workers are very small (about 1/16-inch long); light yellow to reddish brown in color, with the abdomen (hind portion of body) somewhat darker. There is no stinger. The petiole (narrow waist between the thorax and abdomen) has two nodes and the thorax has no spines. Eyes are well-developed. The antennal segments end in a distinct club with three progressively longer segments. This is in contrast to the thief ant's 2-segmented club.

Pest Status
Very common throughout the U.S. and the most commonly occurring indoor ant; in hospitals, it can be a carrier of more than a dozen pathogenic bacteria, including Staphylococcus, Salmonella, Pseudomonas, and Clostridium; these ants do not sting and usually do not bite.

Life Cycle and Habits
Description: Also called the sugar ant, odorous or piss ant, these are some of the smallest ants, the workers are about 1/12-16-inch-long, with a light tan to reddish body. Over 200 species of ants are known to exist in the U.S. A number of other ant species are occasionally encountered in and around the home.

Life Cycle
Development of worker ants progresses from eggs (5-6 days), to several larval stages (22-24 days), pre-pupal stage (2 to 3 days), a pupae (9-12 days), and adult ants, thus taking from 38 to 45 days from egg to adult (4 days longer for sexual forms). Colonies consist of one to several hundred queen ants, sterile female worker ants, periodically produced winged male and female reproductive ants (sexuals), and brood (developmental stages). These ants do not swarm. Colonies multiply by "*budding*", whereby a large part of an existing colony migrates, and carrying brood to a new nesting site.

Female Pharaoh
A Female Pharaoh ant can lay 400 or more eggs in her lifetime. Most lay 10 to 12 eggs per batch in the early days of egg production and only 4 to 7 eggs per batch later. At 80°F and 80 percent relative humidity, eggs hatch in 5 to 7 days. The larval period is 18 to 19 days, prepupal period three days and pupal period nine days. About four more days are required to produce sexual female and male forms. The entire life cycle takes about 38 to 45 days depending on temperature and relative humidity. Unlike most ants, they breed continuously throughout the year in heated buildings and mating occurs in the nest. A single queen can produce many hundreds of workers in a few months. Mature colonies contain several queens, winged males, sterile females or workers, eggs, larvae, pre-pupae, and pupae growing to as large as 300,000 or more members.

Periodically a queen, together with a few workers carrying immatures (eggs, larvae, and pupae), leaves the nest and sets up a new colony elsewhere, quickly spreading an infestation. This behavior pattern is known as "*satelliting*," "*fractionating*" or "*budding*" where part of the colony migrates to a new location rather than by single females dispersing after a reproductive swarm. Budding may occur due to overcrowding, seasonal changes in the building's central heating and cooling system, or application of a repellent pesticide.

Nests are often so small they can be contained in a thimble, located between sheets of paper, in clothing or laundry, furniture, foods, etc. Nests usually occur in wall voids, under floors, behind baseboards, in trash containers, under stones, in cement or stone wall voids, in linens, light fixtures, etc.

They prefer dark, warm areas near hot water pipes and heating tapes, in bathrooms, kitchens, intensive care units, operating rooms, etc. They are "*trail-making*" ants and often are found foraging in drains, toilets, washbasins, bedpans, and other unsanitary sites, as well as in sealed packs of sterile dressing, intravenous drip systems, on surgical wounds, food, and medical equipment.

Habitat, Food Source(s), Damage
Mouthparts are for chewing. Pharaoh ants are omnivorous, feeding on sweets (jelly, particularly mint apple jelly, sugar, honey, etc.), cakes and breads, and greasy or fatty foods (pies, butter, liver, and bacon). Nests can be found outdoors and almost anywhere indoors (light sockets, potted plants, wall voids, attics, in any cracks and crevices) particularly close to sources of warmth and water.

Pharaoh Ant Control Measures
Pharaoh ants are usually much harder to control than other ants because of their ability to disperse. There may be dozens or hundreds of colonies in a single building and when a few colonies are missed during control, populations will quickly rebound.

About 90 percent of the colony remains hidden in the nest, so even if 10 percent of the colony is killed by a residual pesticide, the remaining reservoir of ants is enormous. Conventional contact pesticide applications, especially repellent products such as pyrethrins, may spread infestations to new areas with multiple colonies blossoming within the structure. These ants will avoid certain pesticides. Control is difficult and often long term (months to years), depending on the building size, wall voids, etc., especially in hospitals and food plants. Complete cooperation from the property manager and residents is essential for a successful control program.

Inspection
Carefully examine the building inside and outside from the roof to the basement, finding the ant distribution, population size, and food sources. Locate ant trails, following them to where feeding occurs. A single stream of ants moving in one direction may indicate colony movement, not foraging. Mark the established feeding trail with a sticker and date. Trails with many ants coming and going indicate a large colony. Pre-baiting (dilute honey or peanut butter on three-by-five cards) helps to identify "*hot spots*," but with experience, one will already know where such places are located. In the winter, these ants tend to concentrate near and around heat, whereas in the spring and summer, they move to the outside walls and distribute themselves throughout the building. Carefully check areas with moisture, such as pipes, faucets, air conditioners, refrigerators, drains, leaking roofs, etc.

Prevention
When insecticides are prohibited around high-tech equipment and in health areas, use sticky tapes, double-faced adhesive tapes, and masking tape (glue side out) wrapped around objects as barriers. Use a ring of petroleum jelly, non-hardening glues, sticky dust mats, or glue boards under equipment legs. Seal cracks and voids with caulking compound after applying low residual repellent insecticides such as chlorpyrifos (*Dursban*) or *Diazinon*.

Insecticides
In areas of active colonies, treat walls and ceiling voids through cracks and crevices with non-repellent boric acid dust and make bait placements. Keep the ants in the area long enough to get the slow-acting toxicants to the main colony where the workers, larvae and queens are poisoned. (A delayed-action stomach poison is recommended.) Repellent insecticides, such as pyrethrins, will move the colonies, spreading them further throughout the building.

Research has shown that it is best to use bait placement only where active ant trails are found. This ensures feeding, since some ants have not been able to find the bait even when only one inch away from the bait stations. Intersect the ant trail with bait on a cotton swab taken from the station to ensure instant feeding.

Bait preference may change during the season due to changing needs of the developing colonies. An effective bait is a 99 percent boric acid formulation mixed at a 5 percent concentration by weight in mint apple jelly (about two level tablespoons of powdered boric acid per 10 ounces of mint apple jelly). Another bait is 2 percent boric acid and 98 percent light corn syrup.

Methoprene
A commercial bait called methoprene (Pharorid) is marketed for use by pest control operators in a bait that consists of liver, honey, and sponge cake. It is often difficult to use the bait ants prefer; as ants feed on one compound, another compound placed less than 1/4-inch away will be ignored until the ants spill over into the second bait.

Boric Acid
Boric acid and methoprene baits work slowly, sometimes taking 15 to 40 weeks or more before ant eradication. A bait containing hydramethylon (same as in Maxforce roach bait stations) gives quicker results, 2 to 35 days, according to certain pest control operators.

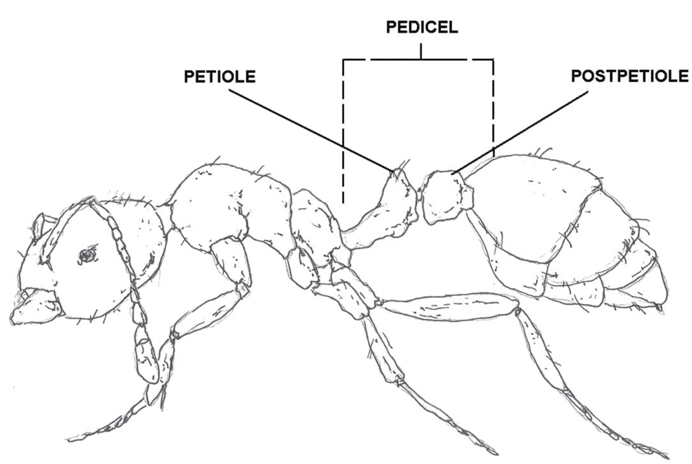
Bait stations may include jumbo size plastic drinking straw sections, medicine (pill) dispensing cups, plastic vial caps and/or drafting (masking) tape. Placement can be made on the rear lip of kitchen counters, at plumbing pipe-wall junctions, on window sills, behind wall electrical outlets, above door frames, etc., in less accessible areas of pets or young children.

There may be increased or new ant feeding activity during the early part of the baiting program. No other pesticides, heavy-duty cleaners, or paints should be used during the baiting periods to discourage ant feeding.

Bendiocarb
Applications of bendiocarb (Ficam), which is odorless, can give fast eradication of Pharaoh ants if treatments are thorough. Ficam 76 percent WP and 91 percent dust is labeled for licensed commercial and pest control operators. The bait products most recommended for Pharaoh ant control include: (boric acid plus mint apple jelly (Drax), hydramethylnon (Maxforce), methoprene (Pharorid), bendiocarb (Ficam), propoxur (Baygon) and sulfluramid (Pro-Control)).

After bait stations are placed, one will see ants trailing to and from these bait stations. Do not spray or disturb the ants or bait stations. Ants must be allowed to carry the bait back into their nest where the active ingredient in the bait will eliminate the colony.

Usually, Pharaoh ant control is best achieved by a licensed pest control operator or applicator who is trained, experienced, and has the proper equipment--an Applicator like yourself. Before using an insecticide, always read the label, follow directions and safety precautions.

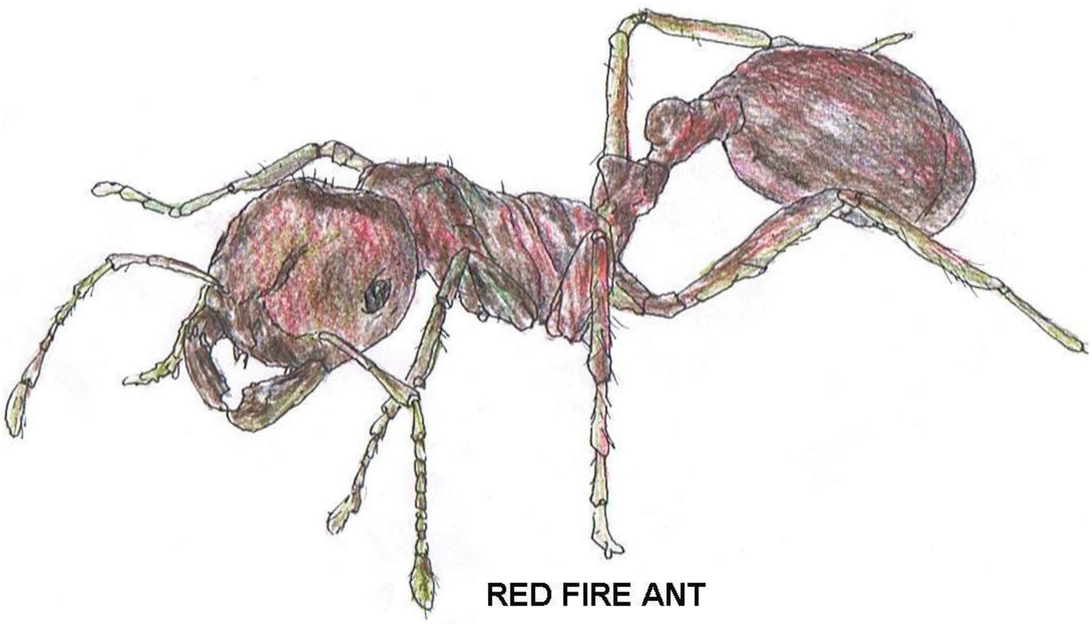


PHARAOH ANT

Red Imported Fire Ants RIFA *Solenopsis invicta* – 2 Node Ant

Red imported fire ants (RIFA) are medium sized ants that build mounds of soft soil rarely larger than 18" in diameter. The ants emerge out aggressively when they are disturbed and sting. Their sting usually leaves a white pustule the next day. Harvester ants are much larger and make large bare areas with a single entrance hole to the colony. Leaf cutter ants are also much larger and do not have a distinctive built-up mound, but do have many entrance holes over a very large area. Other small to medium-sized ants that build small mounds will actually run away from disturbances and aren't fire ants.

Some confusion comes from the fact that red imported fire ants come in a variety of sizes (1/16 to almost 1/4-inch-long) with the largest workers 2 or 3 times larger than the smallest. Native fire ants are less common in imported fire ant infested areas. Solenopsis geminata is the most common native fire ant species encountered. To the unaided eye, they are almost identical to red imported fire ants. However, geminata will have a few larger workers with large, square-shaped heads. These ants specialize in collecting and milling seeds.



RED FIRE ANT

Queens

Single queen (monogyne form): only one queen per colony or mound; slightly larger workers; members of colonies are territorial; mound densities usually 2080 mounds per acre; fewer ants per acre.

Multiple queen (polygyne form): dozens of queens per colony; smaller average worker ants; colonies are interconnected; mound densities 100 to 1,000+ per acre; more ants per acre.

Difference between Fire Ants and Termites

Although most ants are recognizable, some forms of winged ants are often confused with termites, especially during the termite swarming season. The front pair of wings on ants is larger than the hind pair, while the four wings of termites are approximately the same size. Ants have "*elbowed*" antennae and a "*thin waist*," being narrow between the thorax and hind abdominal segments. Termites have the thorax and abdomen broadly connected and their antennae are straight and hair-like.

History

Where are Fire Ants From?

Fire ants are from South America. They entered the U.S. through Mobile, Alabama, probably in soil used for ships' ballast. They were accidentally introduced around the 1930s and have been spreading ever since.

We Didn't Used to Have Fire Ants When I Was a Child. Why Do We Have Them Now?

Red imported fire ants are very aggressive, efficient competitors. Since the 1950s, the ant has been spreading northward, westward, and southward from Texas. Their northward spread depends on temperature. Cold winters tend to push them back. Western spread is largely dependent on water. They will mostly be found in urban areas, creek bottoms, irrigated land, etc. The entire Pacific Coast is fertile ground for infestation. The bad news is that they are probably here to stay. The good news is that with relatively little cost and effort, you can prevent most of the problems they cause using currently available methods.

Fire ant mound; right side is Fire ant damage to an electrical transformer.

Medical Importance

Why Do Fire Ants Appear to Sting at the Same Time?

Fire ants are sensitive to vibration or movement and tend to sting when the object they are on moves. The ants swarm up a person's leg, and when one ant stings, that person jerks or moves. This triggers many of the other ants to sting in response. Thus, it appears they all sting at the same time, and most do.

Is Their Sting Lethal?

Only to a very small portion of the population who experience severe allergic reactions. Fire ants inflict a fiery sting, which causes a small blister or pustule to form at the site of each sting after several hours. The blisters become itchy while healing and are prone to infection if broken.

If You are Stung by a Fire Ant:

Apply a cold compress to relieve the swelling and pain.

Gently wash the affected area with soap and water and leave the blister intact. People who are allergic to insect stings should seek medical attention immediately. On rare occasions, fire ant stings can cause severe acute allergic reaction (anaphylaxis).

What Should I do if I Get Stung?
There really isn't much you can do, except watch the area for excessive swelling, itching, or redness, or other symptoms like shortness of breath, thickening of the tongue, sweating, etc., that could indicate a systemic allergic reaction. Treat stings as you would stings of other insects, and keep them clean and intact to avoid getting secondary infections.

What if I Have an Allergic Reaction?
Seek medical help immediately!

Are They as Lethal as Killer Bees?
They both attack in masse and both can cause fatal allergic reactions, but that's where similarities end. Africanized bees can overwhelm and kill even healthy, non-allergic people, but encounters are rather rare. Fire ants can't overwhelm a healthy, mobile person and even hundreds of stings are rarely fatal. However, fire ant mounds are extremely common. So the chance of being killed by bees is higher if you come across them, but the chance of being killed by fire ants is higher only if you are highly allergic or cannot quickly get away from them. The chances of either are very small.

Impact of Red Imported Fire Ants
They're killing the Quail, Deer, Lizards, Songbirds, Horny toads, etc. Why Isn't Anything Being Done?
There are things being done, but it's not an easy problem to solve. First, imported fire ant control using today's methods provides only temporary suppression and costs money on a per- area basis. Wildlife occurs over large areas, which means it would make the cost of periodic treatments prohibitive. Research is being supported to document the impact of the imported fire ant on wildlife and evaluate ant management approaches. While some wildlife species are undoubtedly declining due to fire ants, they are also declining due to land use practices and weather extremes, for instance. There is great hope that the biological control agents currently under investigation will spread into wildlife areas and permanently reduce imported fire ant populations there.

Are the Ants Killing my Trees?
The ants are mainly using the trees as a nesting place. Ants in mounds occurring at the base of the trunk are probably not causing any damage to well-established trees and may actually be helpful by preying on other insects that are feeding on parts of the tree and reducing compaction by tunneling in the soil.

Why Do Fire Ants Get into Laundry?
This is a convenient place that resembles lots of tunnels for the ants. Often reports of ants in laundry occur following a flood or severe drought and are observed in utility rooms, bathrooms, or near the water heater where ants have access to the area from outside. When it floods they move in into any good dark place but in drought conditions, they tend to move to moist areas.

Fire Ant Management Approaches
Can Fire Ants be Eradicated Completely?
Red imported fire ants cannot be eradicated completely with methods available today. They can be eliminated temporarily from small areas, with proper control methods. Their biology and spread make it economically, technically, and ecologically impossible to eradicate them from larger areas.

What is the Best Product for Killing Fire Ants?
There probably is no single "*best*" method for managing RIFA. Technical Learning College does not like to endorse any specific products but will mention products, which we have tested in the field.

How Do I Eliminate Them from My Yard?
There is no single, easy answer for every situation. Most people with more than a handful of mounds will be most satisfied with just bait or the Two-Step Method. Remember, no method is 100% effective all the time, though some come close, and no method is permanent. The ants will reinvade, with new colonies probably appearing after the next rain and certainly within a year.

What is the "*Two-Step Method*" for Controlling Imported Fire Ants?
One proven method of reducing imported fire ant populations in heavily-infested home lawns and ornamental turf is called the "*Two-Step Method*" of fire ant control.
Briefly, it's the:
1) once or twice per year broadcast application of a bait product (e.g., Amdro®, Logic®, Award®, or Ascend® and others) and waiting several days to a week before;
2) treating nuisance mounds, using an individual mound treatment, such as a dust, granule, bait or drench insecticide. Otherwise, wait for the bait treatment to take effect. This method reduces the over-reliance on use of individual mound treatments and is suitable for treating larger areas.

Why Tackle Fire Ants in the Fall?
An ideal time to apply bait-formulated fire ant insecticides is from late August through October to allow the baits to reduce fire ant populations over the winter.

It's been Dry and I Don't See Them. Are they Still Around? Why Should I Treat Them Now?
The ants are still there, just not making mounds because of the heat and drought. They are deep in the ground during the day and come out to forage at night. Ants are often more of an indoor problem now, as they come in after food and water. Treating now can be very effective since the ants are weakened anyway. Using individual mound treatments during hot, dry conditions is not a good idea because mounds are absent and/or ants are deep. Baits can work quite well if the ants are out foraging to pick it up. It is best to treat in the late afternoon or evening. You will need to know if thunderstorms are a possibility, be sure there is no dew on the grass, and make sure the bait will not have to sit in the hot sun all day. Most of the bait will be picked up by morning.

Which Bait do I Use? Baits Take Too Long. Baits Don't Work. The key to using baits is patience. Applied properly and using a fresh bait product, a broadcast application will give 80% to 90% control, rarely 100%. For instance, Amdro® is the fastest acting, giving maximum control in 3 to 6 weeks. Logic® or Award®, when applied late in the year, may take several months to provide maximum control, but will suppress ant colonies for a year or more.

One approach, for heavy imported fire ant infestations is to treat with Amdro® first for fast knockdown, then come back with Logic®/Award® for longer durations of control as ants start to re-infest the area some months in the future. Other baits include Siege®, Award®, Ascend®, and Raid® Fire Ant Killer.

We Tried Using Those Baits, But They Don't Seem to Work. I'd Like to Use Something Safe. What Do you Recommend?
The baits do work when used properly. The thing to remember is the ants collect the bait as a source of food. Baits will go rancid in a relatively short time, as does other food that contains oil.

Additionally, putting the bait out at the right time of day and at the correct rate (1 to 1 1/2 lb./acre) is critical. If the ants are not actively foraging, they will not pick up the bait. The best times to make bait applications generally are midmorning after the dew has evaporated, or late afternoon on hot days when the air begins to cool. Always read and follow closely the directions provided on the product label before using any pesticide.

Are There any Biological Controls Out for Fire Ants? I Heard About a Fly that is Supposed to Kill Fire Ants, What's the Story on That?
The United States Department of Agriculture is conducting research on the Phorid fly as one of several potential biological control agents for helping to control fire ants. However, this research is in the beginning stages. We may be years away from any type of control these flies may provide.

Even in South America, where the imported fire ants and parasitic flies come from, the flies only affect about 3% of the ants in a colony. Some biological control agents that have already been marketed include predaceous mites, parasitic nematodes, and the fungus called Beuveria bassiana. Scientific studies are being conducted to evaluate the effectiveness of some of these natural enemies, but others remain untested or have not been shown to be highly effective when used as directed.

Why Don't We Use Mirex?
Mirex was an effective ant killer, but it was one of the most persistent compounds ever made. Mirex belongs to a group of chemicals that have mostly been banned from sale or use because their ingredients, or their degradation products, accumulated in biological systems.

Over-the-Counter Baits
Over-the-counter baits at consumer retailers are limited to *Amdro* and *Combat* (hydramenthylnon); *Raid Ant Bait* (abamectin) - which is now an old product; *Spectracide Ant Bait* (pyripoxyfen) which is formulated at 1/10th "*conventional*" formulation concentration and costs 10 times as much to apply as conventionally formulated products.

Step One: Baits
Fire ant baits consist of pesticides on processed corn grits coated with soybean oil. Worker ants take the bait back to the colony, where it is shared with the queen, which then either dies or becomes infertile. Baits currently available include Amdro, Siege, Logic, Award, Ascend, or Raid Fire Ant Killer. Baits are slow-acting and require weeks or months to achieve 80% to 90% control.

Bait Products
Bait products can be used to easily treat large areas effectively. They contain extremely low amounts of toxins.

For best results:
- Use fresh bait, preferably from an unopened container.
- Apply when the ground and grass are dry and no rain is expected for the next 24 to 48 hours.
- Apply when worker ants are actively looking for food, usually in late afternoon or in the evening. To test, put a small pile of bait next to a mound and see if the ants have found it within 30 minutes.
- Apply baits with hand-held seed spreaders. Don't apply baits mixed with fertilizer or seed.
- Baits can be applied anytime during the warm season. When applied in late summer/early fall, ants are still foraging, and it's easier to predict weather patterns. Then the bait can take effect over the winter while you're indoors. Re-apply baits once or twice a year.

Step Two
Individual Mound Treatments Chemical: With dust products, no water is needed and they act fast. However, they leave a surface residue. Liquid drenches generally eliminate mounds within a few hours and leave little surface residue after application. Granular products are relatively fast acting and usually require putting granules on and around the mound and then sprinkling 1 to 2 gallons of water on them without disturbing the mound. Closely follow directions on the label.

Organic: Pouring 2 to 3 gallons of very hot or boiling water on the mound will kill ants about 60% of the time. Otherwise, the ants will probably just move to another location. Very hot or boiling water will kill the grass or surrounding vegetation that it is poured upon. Other natural or organic methods include mound drench products containing plant derived ingredients (e.g. botanical insecticides) and biological control agents.

Key Words

Protectant: A pesticide applied to a plant or animal prior to the appearance or occurrence of the pest in order to prevent infection or injury by the pest.

Repellant: A compound that keeps or drives away insects, rodents, birds or other pests from plants, domestic animals, buildings or other treated areas.

Secondary reproductive: A caste of subterranean termite; also called supplemental reproductives. If these termites develop from nymphs, they are called secondary reproductives (primary reproductives are the king and queen). If they develop from pseudergates, they are called tertiary reproductives.

Applicators Must Think About These Concerns:

- Where will the pesticide go after it leaves its container or application equipment?
- What effects could it have on those non-target sites it may reach?
- What can I do to minimize harmful effects?

Pesticide Primary Characteristics
Solubility
Is a measure of the ability of a pesticide to dissolve in a solvent, usually water. Highly soluble pesticides dissolve easily in water. They are more likely to move with surface water in runoff or by leaching down through the soil than less soluble pesticides.

Adsorption
Measure how well a pesticide sticks to soil particles. It occurs because of the attraction between the chemical and soil particles. Typically, oil-soluble pesticides are more attracted to clay particles and organic matter in soil than water-soluble pesticides. Also, pesticide molecules with a positive (+) charge are tightly adsorbed to negatively (-) charged soil particles. A pesticide that adsorbs to soil particles is less likely to move from the spray site than one that does not adsorb tightly to soil.

Persistence
Is the ability of a pesticide to remain present and active in its original form for a long time before breaking down. Persistence is described in terms of half-life: the time needed for 50% of the chemical to break down (degrade). The longer the half-life, the more persistent the pesticide.

Residue
The amount of pesticide that remains in the environment after an application or a spill. A residue is desirable when it provides long-term pest control and reduces the need for repeated applications. However, some persistent pesticides can harm sensitive plants or animals, including humans. Therefore, it is especially important to prevent persistent pesticides from moving offsite through improper handling, application, drift, leaching, or runoff.

Liquid Formulations
Liquid formulations are generally mixed with water, but in some instances labels may permit the use of crop oil, diesel fuel, kerosene, or some other light oil as a carrier. This section will present more detailed information about the common liquid pesticide formulations.

Aerosols (A)
These formulations contain one or more active ingredients and a solvent. Most aerosols contain a low percentage of active ingredients. There are two types of aerosol formulations: the ready-to-use type commonly available in pressurized, sealed containers and those products used in electric- or gasoline-powered aerosol generators that release the formulation as a “smoke” or “fog.”

Liquid Baits
An increasing number of insecticides and rodenticides are being formulated as liquid baits. Liquid rodenticides are mixed with water and placed in bait stations designed for these products. They have two major benefits. Liquid rodenticides are effective in controlling rodents, especially rats, in areas where they cannot find water. They are also effective in areas of poor sanitation where readily available food renders traditional baits ineffective.

Dry or Solid Formulations
Dry formulations can be divided into two types: ready-to-use and concentrates that must be mixed with water to be applied as a spray. This section will present more detailed information about the common dry or solid pesticide formulations. Dusts (D) Most dust formulations are ready to use and contain a low percentage of active ingredients (usually 10% or less by weight), plus a very fine, dry inert carrier made from talc, chalk, clay, nut hulls, or volcanic ash. The size of individual dust particles varies.

Granules (G)
Granular formulations are similar to dust formulations except granular particles are larger and heavier. The coarse particles are made from materials such as clay, corncobs, or walnut shells. The active ingredient either coats the outside of the granules or is absorbed into them. The amount of active ingredient is relatively low, usually ranging from less than 1 to 15 percent by weigh.

Wettable Powders (WP or W)
Wettable powders are dry, finely ground formulations that look like dusts. They usually must be mixed with water for application as a spray. A few products, however, may be applied either as a dust or as a wettable powder; the choice is left to the applicator. Wettable powders contain 5%–95% active ingredient by weight, usually 50% or more. The particles do not dissolve in water. They settle out quickly unless constantly agitated to keep them suspended.

Water-Dispersible Granules (WDG) or Dry Flowables (DF)
Water-dispersible granules, also known as dry flowables, are like wettable powders except instead of being dustlike, they are formulated as small, easily measured granules. Water-dispersible granules must be mixed with water to be applied. Once in water, the granules break apart into fine particles similar to wettable powders. The formulation requires constant agitation to keep them suspended in water. The percentage of active ingredient is high, often as much as 90 percent by weight.

Soluble Powders (SP or WSP)
Soluble powder formulations look like wettable powders. However, when mixed with water, soluble powders dissolve readily and form a true solution. After they are mixed thoroughly, no additional agitation is necessary. The amount of active ingredient in soluble powders ranges from 15% to 95% by weight; it usually is more than 50%. Soluble powders have all the advantages of wettable powders and none of the disadvantages except the inhalation hazard during mixing. Few pesticides are available in this formulation because few active ingredients are readily soluble in water.

Water-Soluble Packets (WSB or WSP)
Water-soluble packets reduce the mixing and handling hazards of some highly toxic pesticides. Manufacturers package precise amounts of wettable powder or soluble powder formulations in a special type of plastic bag. When you drop these bags into a filled spray tank, they dissolve and release their contents to mix with the water.

Fumigants
Fumigants are pesticides that form gases or vapors toxic to plants, animals, and microorganisms. Some active ingredients are formulated, packaged, and released as gases; others are liquids when packaged under high pressure and change to gases when they are released. Other active ingredients are volatile liquids when enclosed in an ordinary container and, therefore, are not formulated under pressure. Others are solids that release gases when applied under conditions of high humidity or in the presence of water vapor.

Ant Prevention and Elimination – Intro to Control Procedures

Prevention is the best line of defense against the establishment of any pest insect. Relatively small ants, such as the white-footed ant can fit through extremely small openings to gain access into the home. If these entry points can be located, they can be blocked by application of caulk or some other exclusion device. This can also help to prevent other insects from gaining access into your home.

Control Strategies
There are two categories of ants that will be encountered with an ant problem. The control strategy that you should take depends on your type of infestation. Ants that live outside and forage in the home.

Ants that live outside will travel inside the home to search for food. Some species may ultimately reside in houses, discussed later in this fact sheet. To prevent both of these scenarios, follow these procedures:

- First, cracks and crevices should be sealed to eliminate passages into the home. If you do not seal entry points, ants will probably find their way into your house at some later time.
- Second, scrub around entry points with a detergent (to remove the trail pheromone) and spray a residual insecticide around entry points.

Specific Actions
If the nest is exposed (e.g. due to remodeling or reroofing) you can use a liquid or aerosol ready-to-use insecticide, such as bifenthrin, cyfluthrin, deltamethrin, or permethrin. Spray the insecticide directly into as much of the nest as possible. The more of the colony that is exposed, the better your chance of destroying it. It is necessary to anticipate an ant colony and have a product ready at the start of construction.

Once the nest is exposed, that portion of the colony will try to relocate to protect themselves.

Sprays on surfaces where ants travel or congregate, such as along baseboards or in holes or cracks in the walls and floors, may reduce the frequency and number of ants you see. However, they are not effective in eliminating a nest because 1) the ants carry very little insecticide back to their nests and 2) most ants forage outside and do not come in contact with the insecticides. Be aware of the potential for more than one nest in a building, but only treat nests that you know exist. Do not treat areas of a building if additional nests are not found.

Once a carpenter ant nest is treated, continue to watch for evidence of an active nest until the following spring. If no evidence is observed, then further insecticide applications are unnecessary.

What to Do If You Have an Ant Emergency
Baits take time to work so continue to clean up trails.

- Determine what the ants are attracted to and remove the food source.
- Indoor sprays are not usually necessary.
- Put out bait stations or apply gel bait at entry points.
- Vacuum trails, wipe them with soapy water, or spray with window cleaner.
- Locate entry points and caulk openings or plug with petroleum jelly

Pesticides are Broken Down or Degraded by:

1. **Chemical degradation** usually involves a chemical reaction with water; it does not involve living organisms.
2. **Microbial action** is the breakdown of chemicals by soil microorganisms, such as fungi or bacteria.
3. **Photodegradation** is the breakdown of chemicals in reaction to sunlight.
4. **Volatility** is the tendency of a pesticide to turn into a gas or vapor. Some are more volatile than others. The chance of volatilization increases as temperatures and wind increase. In addition, volatility is more likely under conditions of low relative humidity because evaporation increases in drier conditions.

Improper application of ant bait, it should be place or dripped on a hard surface.

Ant Bait Treatments Sub-Section- Introduction

Bait treatments and insecticides can be used to control ants in the outside nest. To be effective baits must be placed in areas where ants frequent, eaten and be taken back to the nest. There are several different kinds of baits available, and you may have to do a little trial-and-error to find the proper bait. Because the ants must get back to the nest for satisfactory control this strategy may be incompatible with insecticide sprays which may kill worker ants before they can get back to the nest with the bait. The successful use of a bait may take several weeks or more. Insecticide dilutions can be used outside to successfully drench ant nests. Be sure to follow label recommendations for correct procedures when applying the insecticide.

If the nest cannot be located, baits may be an effective alternative. Baits work by combining an attractive food source with a slow-acting toxicant. A delayed toxicant is critical because it allows the ants to forage normally for days or even weeks. During that time, ants consume the bait and return to the nest to share the bait with the rest of the colony. In a process known as trophallaxis, one ant regurgitates its stomach contents to another ant. This food sharing behavior enables the bait to be spread throughout the colony before the toxicant takes effect.

There are a few baits available to nonprofessionals for carpenter ant control. Most retail products are liquid or granular formulations containing hydramethylnon, sulfluramid, abamectin, or boric acid. An inexpensive liquid bait of 1% boric acid in a 10% sugar water solution can be mixed at home, but it is very slow acting and must be constantly replenished. Baits vary a great deal in their effectiveness. Carpenter ants have complex food preferences, and some of the sugar-based baits will not be attractive to the ants long enough to be successful.

Outdoors
Often carpenter ant nests found indoors are satellite nests that can be traced back to a parent colony outdoors in trees, stumps, roots, fence posts, landscape timbers, and other wood structures. When possible, remove wood that contains carpenter ant nests, or destroy the colony. When this is not practical, and carpenter ants are discovered entering your customer's home from outdoor nests, a treatment with a residual insecticide around the building's exterior helps keep them out of the home. As before, be sure the product you intend to use is labeled for use around building exteriors.

Products, such as bifenthrin, cyfluthrin, or permethrin, are also available to homeowners. Only professional pest control services should treat the home's exterior.

Spray the product in a band, covering the foundation and under the lower edge of the siding to help keep ants from coming inside. Trim branches that overhang buildings or electrical wiring to avoid giving carpenter ants easy access to your home. Note: Be sure the tree or shrub species can be pruned at the time you wish, e.g. do not prune oak between April 15 and September 15 because of the risk of oak wilt. Treating the building's exterior is a short term control measure. A permanent control method is to eliminate or remove the nest. If this cannot be done directly, then use baits to eradicate the outdoor colony.

Pesticide Treatments General Applications
Chemical Control. Ants can be controlled with baits, crack and crevice treatments, indoor space and surface treatments, outdoor barrier and broadcast treatments, as well as void and attic treatments.

However, methods that target individual trails of ants such as crack and crevice treatments and indoor space and surface treatments are usually a “quick fix” and ineffective in the long term because they do not significantly reduce the ant population and do not affect the queen. Ant baits, however, were developed to exploit the foraging and nest mate feeding behaviors of ants. Bait treatments are effective for control of many ant species and are available in homeowner and professional product versions.

Since ants rely heavily on trophallaxis (reciprocal feeding), the bait toxicant can be thoroughly distributed to the members of the colony, including the queen and brood. Baits are effective because they not only kill the foraging members of the colony, but they kill the queen(s) so no other ants are produced. The ideal bait contains a slow-acting, non-repellent toxicant that is incorporated into a preferred food substrate. There are many types of baits on the market.

Some baits contain:

- Insect growth regulators that primarily impact brood production and development (Extinguish, Award, Distance, etc.)
- Metabolic inhibitors that primarily kill the foraging workers, the brood and queen (Amdro, Combat, etc.)

In general, ant baits can be found as:

- Granules for broadcast
- Liquids
- Gels
- Ready-to-use, tamper resistant containers

Perimeter Insecticide Treatments

The most commonly used method for controlling carpenter ants is treating the perimeter of a home with a dust or spray. There are several products available for this type of application, but Suspend SC, Talstar Concentrate and Cynoff WP are the best. When used in accordance with their labels they work well. However, these treatments do not keep ants from entering a home from overhead trees and power lines. Also, as a stand-alone treatment, they rarely eliminate ants inside voids and walls.

Recommended Products and Treatment

Baiting is the preferred treatment over typical residual spraying, to eliminate the entire colony. The use of residual sprays or dusts will cause stress on the colonies, causing them to split into sub-colonies that scatter to other areas in the structure. This is also called budding. After spraying, the problem can be worse than at the beginning. When you bait, you will want a slow-acting bait.

Quick-kill insecticides and baits will only kill the foraging ants, not allowing the foraging ants to take the bait back home to feed the queen, nest workers and brood. If the current ant bait that you are using is not acceptable to the ants (if they are not visiting the bait), it is recommended that you change the baits. Ants require carbohydrates sugars, proteins, and greases. They find a variety of these sources in nature. Examples are: other insects (proteins and greases), nectar, aphid honeydew, and plant products (sugar and carbohydrates).

The Recommended Products for the Protein/Grease Eating Cycle Would Be:

- Maxforce Ant Bait Stations
- Flourguard Ant Bait Stations
- Maxforce Ant Granulars
- Advance Carpenter Ant Bait

The Recommended Products for the Sugar Eating Cycle Would Be:

- Maxforce Ant Killer Bait Gel
- Uncle Albert's Gel Bait
- Revenge Liquid Ant Bait
- Maxforce Granular Ant Bait is an excellent choice for the outside, feeding all their dietary needs.
- Ant bait stations such as: Ant Cafes small or large plastic cubes (that snap shut) that keep the gel or dry granulated bait inside, may serve to keep the baits intact.
- Dr. Moss Liquid Ant Bait can be applied to areas where ants are foraging. For use of Dr. Moss Liquid Ant Bait, you should use the Dr. Moss Liquid Ant Bait Station

Perimeter Treatment with Good Residual Sprays Such As:

- Suspend or Demon WP can at times prevent these ants from entering the structures.

Key

The key to using baits is patience. Applied properly and using a fresh bait product, a broadcast application will give 80% to 90% control, rarely 100%. For instance, Amdro® is the fastest acting, giving maximum control in 3 to 6 weeks. Logic® or Award®, when applied late in the year, may take several months to provide maximum control, but will suppress ant colonies for a year or more.

One approach, for example, for heavy imported fire ant infestations is to treat with Amdro® first for fast knockdown, then come back with Logic®/Award® for longer duration of control as ants start to re-infest the area some months in the future. Other baits include Siege®, Award®, Ascend®, and Raid® Fire Ant Killer.

Regular Inspections

Regular inspections and service are necessary to find and treat new colonies as they move in from neighboring properties. These perimeter treatments can keep your home or business pest free. We suggest a regular treatment on the exterior with Demand, Tempo, or Suspend.

Procedure to Locate and Treat Colonies

Drench colonies living in the soil or under items on the exterior with Demand, Suspend, or Tempo. With mulch, be sure to rake it back to get good penetration where colonies may be thriving. Follow up with a broadcast application of granule such as Talstar G. If you know with some certainty where the colony is living inside, then you can treat them directly by drilling a small hole into the wall void at the base (directly above the baseboard) and injecting a dust, such as Delta Dust, Drione, or Borid Turbo.

General tips for limiting ant infestations include:

- Eliminate piles of lumber, bricks, or other debris that could serve as nesting sites for ants.
- Keep landscape mulch less than 2 inches thick and at least 12 inches away from foundations.
- Ensure the sprinkler system does not spray directly onto the foundation.
- Seal as many cracks in the building's exterior as possible.
- Keep tree and shrub branches cut away from touching the building.
- Consider re-landscaping to avoid using plants that are prone to aphids and similar insects.
- At the very least, treat such plants for aphids regularly.

A thorough inspection both inside and outdoors is crucial to determine ant nest location(s). Inside look primarily near moisture sources (sinks, potted plants, etc.) and secondarily near food sources (sweets stored in cabinets, etc.). Check carpet edges and shoe moldings. Inspect electrical outlets and telephone jacks, especially in the kitchen and bathroom.

Check walls around possible entryways (window and door frames, utility lines, weep holes, etc.) for trails of ants as well as along edges and corners. Follow any trails of ants back to their nest. If the ants are associated with an outside/ perimeter wall, then go outside and look for ants trailing along the wall on the opposite side.

If the nest(s) cannot be located, it may be necessary to prebait with sweets such as jelly in short pieces of soda straw to draw the ants out. Place such prebaits where ants have been seen, in electrical outlet boxes, along carpet edges, in food cabinets, etc. Check these prebait placements in 24-48 hours for activity. If ants cannot then be found coming in from outdoors, use one of the commercial baits for control. Try both protein-based and sweet baits.

Turn over any stones, bricks, logs, firewood, and debris on the ground especially near the foundation; as much as possible such items should be eliminated. Check any branches of trees/shrubs in contact with the structure; these should be trimmed back to eliminate contact. Follow trailing ants back to their nest. Treat nests with an appropriately labeled pesticide.

Specific and General Ant Treatment Chemicals/Products and Applications

TERMIDOR is a wonderful pesticide for ant control but is not designed for ants but for termites only. This unique formulation is slow acting and as ants travel over surface areas, they'll be picking up a dose of active that will eventually spread throughout their nest. Within 4-8 days, it will effectively shut down any nests it is carried to making it both effective yet easy to use without knowing where the nests are located.

Nevertheless, if you can see where the nest is located, a direct treatment with the DRIONE will be fast and immediate. TLC does not like to select trade names or specific products but these are commonly found pesticides and we have examined the control effects in our field studies.

If you have a pesticide product and would us to list it or modify information on the following products, please contact us and we will be glad to test, list, or modify your product's information. This information does change and we want to provide the best possible information.

For the Protein and Grease feeding cycles:

- ✓ Advance375 A Ant Bait (for protein/grease feeding cycles)
- ✓ Maxforce Ant Bait Stations (for protein/grease feeding cycles)
- ✓ Maxforce Bait Granulars (for protein/grease feeding cycles)

Sweet Feeding Cycles:

- ✓ Intice Gelanimo Ant Bait for sweet cycles-not messy, particularly good for Odorous Ants
- ✓ Optigard Ant Bait Gel (for sugar feeding cycles excludes fire, harvester and pharaoh ants)

The powerful, slow acting non-repellent active ingredient, thiamethoxam in Optigard ant gel knocks out workers, brood and queens. Also, Optigard Ant Gel Bait provides a longer window of palatability so, as it ages, ants will continue to feed on the bait without any loss of attraction.

- ✓ Maxforce Ant Killer Ant Bait Gel (for sweet feeding cycles)

Nest Treatments

Unless you can treat the nest directly, spraying is not an effective solution for small ants, unless you use a non-repellent insecticides or "undetectable" liquid treatments such as Dominion 2L, Termidor or Phantom. Phantom liquid of aerosol is labeled for the inside. Optigard Flex is another very good non-repellent labeled for inside for many types of ants.

Dominion 2L and Termidor may not be used inside. Unlike older insecticides, non- repellent insecticides can't be smelled, tasted, or even felt by pests. So they crawl through the treated area, not knowing that by ingesting treated materials or merely contacting the insecticide, they'll die.

Again, workers must eat the bait, take it back to the nest, and feed to the queen and larval ants. This type of control is incompatible with treatments (such as repellent sprays) that prevent workers from returning to the nest with the bait.

Unlike other home-inhabiting ants, the larger carpenter ants cause structural damage to wood by excavating and nesting inside wood structures. Carpenter ants usually do not make nest in healthy wood, but tunnel wood that has become wet and started to decay. The larger Carpenter ants are about 3/8 to 1/2" long. They may be black or red.

One effective method to treat carpenter ants are either by baiting, placing the recommended carpenter ant baits listed below one their trails or the use of a non-repellent insecticide inside called Phantom Liquid or Phantom Aerosol or equivalent chemical.

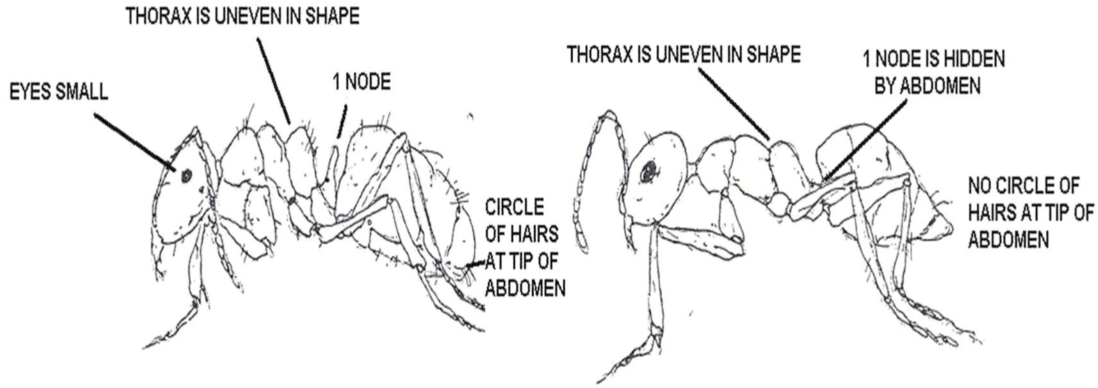
Carpenter ants are most active in the evening hours foraging for food, both inside the house and outside. By following ants at that time, you may be able to tell where to spray or bait.

Treating the carpenter ant nest directly would be the last resort for carpenter ants, as there is a tendency to scatter the colony if you do not treat the nest entirely.

Ant Baits recommended for the Larger Carpenter Ants:(Sugar and Protein Feeding Cycles)

When in doubt of which one to choose, choose one from each category

- ✓ Advance 375 A and Maxforce Carpenter Ant Bait Gel are excellent baits for the larger carpenter ants, when used together they feed both the sugar and protein feeding cycles of these ants. The Advance 375 A feeds the protein needs while the Maxforce Carpenter Ant Bait Gel feeds the sugar requirements of the colony.
- ✓ Advance375 A Ant Bait (for protein/grease feeding cycles)
- ✓ Maxforce Carpenter Ant Gel (for sweet feeding cycles) for carpenter ants are excellent baits.



LARGE YELLOW ANT
(Acanthomyops interjectus)

ODOROUS ANT
(Tapinoma sessile)

Always carry a small powerful flashlight.

Carpenter Ant Infestations

To prevent further carpenter ant infestations, trim all trees and bushes so branches do not touch the house and correct moisture problems such as leaky roofs and plumbing. Paint and/or seal exposed wood construction before it becomes wet. Replace previously ant-infested wood, rotted, or water-damaged wooden parts of the structure and eliminate wood/soil contacts. Remove dead stumps on the property and store firewood off the ground and away from the structure.

Non-Repellents for Outside Ant Control: Dominion 2L, Termidor and Phantom.
Since Dominion 2L (Same as Premise 2) is a non-repellent, carpenter ants, Pavement Ants and Argentine Ants can't detect it; instead, they come directly in contact with the active ingredient, - imidacloprid, without trailing in another area.

✓ Dominion 2L is much more economical than Termidor, but is only labeled for Carpenter Ants, Argentine and Pavement Ants. Dominion 2L is not labeled for Fire ants, Pharaoh or harvester ants.

✓ Dominion 2L is labeled for outside use only and will yield- 50 gallons (strongest dilution rate) compared to Termidor SC- 12 gallons (strongest dilution rate).

Phantom Insecticide and Phantom Aerosol for Inside and Outside Ant Control:
For Roach and Ant control inside use the non-repellent insecticide product Phantom. Phantom will yield 8 gallons for ant control. It is highly suggested that you use a non-repellent such as Termidor SC for the outside in conjunction with the Phantom

Phantom is extremely effective when used alone, or in conjunction with other products such as ant baits. It will not repel pests, or cause them to avoid bait areas. Phantom treatments only require a small amount applied to problem areas to achieve ant control. Phantom is long-lasting, and effective at controlling entire ant and roach populations at low doses. Phantom provides superior roach and ant control by striking ants inside your home where they cause the most trouble. But if you have an ant problem, the ants in your house probably have their nests outside-they travel back and forth. Phantom Aerosol-Convenient form of Phantom in a ready to use spray

Pyrethroids
The pyrethroids are a large family of modern synthetic insecticides similar to the naturally derived botanical pyrethrins. They are highly repellent to termites, which may contribute to the effectiveness of the termiticide barrier. They have been modified to increase their stability in the natural environment. They are widely used in agriculture, homes, and gardens. Some examples are bifenthrin, cyfluthrin, cypermethrin, deltamethrin, and permethrin. They may be applied alone or in combination with other insecticides.

Pyrethroids are formulated as emusifiable concentrates (EC), wettable powders (WP), granulars (G), and aerosols. Certain pyrethroids exhibit striking neurotoxicity in laboratory animals when administered by intravenous injection, and some are toxic by the oral route. Systemic toxicity by inhalation and dermal absorption are low, however—there have been very few systemic poisonings of humans by pyrethroids. Though limited absorption may account for the low toxicity of some pyrethroids, rapid biodegradation by mammalian liver enzymes (ester hydrolysis and oxidation) is probably the major factor responsible. This publication contains pesticide recommendations that are subject to change at any time.

These recommendations are provided only as a guide. It is always the pesticide applicator's responsibility, by law, to read and follow all current label directions for the specific pesticide being used. Due to constantly changing labels and product registration, some of the recommendations given in this writing may no longer be legal by the time you read them. If any information in these recommendations disagrees with the label, the recommendation must be disregarded. No endorsement is intended for products mentioned, nor is criticism meant for products not mentioned. The author and Technical Learning College (TLC) assume no liability resulting from the use of these recommendations.

Most pyrethroid metabolites are promptly excreted, at least in part, by the kidney. In response to dermal exposure, some persons may experience a skin sensitivity called paresthesia. The symptoms are similar to sunburn sensation of the face and especially the eyelids. Sweating, exposure to sun or heat, and application of water aggravate the disagreeable sensations. This is a temporary effect that dissipates within 24 hours. For first aid, wash with soap and water to remove as much residue as possible, and then apply a vitamin E oil preparation or cream to the affected area. Paresthesia is caused more by pyrethroids whose chemical makeup includes cyano- groups: fenvalerate, cypermethrin, and fluvalinate. In addition to protecting themselves from future exposure, persons who have experienced paresthesia should choose a pyrethroid with a different active ingredient, as well as a wettable powder or micro-encapsulated formulation.

About These Pesticides

Pyrethrins and pyrethroids are insecticides included in over 3,500 registered products, many of which are used widely in and around households, including on pets, in mosquito control, and in agriculture. The use of pyrethrins and pyrethroids has increased during the past decade with the declining use of organophosphate pesticides, which are more acutely toxic to birds and mammals than the pyrethroids. This change to less acutely toxic pesticides, while generally beneficial, has introduced certain new issues. For example, residential uses of pyrethrins and pyrethroids may result in urban runoff, potentially exposing aquatic life to harmful levels in water and sediment.

Pyrethrins are botanical insecticides derived from chrysanthemum flowers most commonly found in Australia and Africa. They work by altering nerve function, which causes paralysis in target insect pests, eventually resulting in death.

Pyrethroids are synthetic chemical insecticides whose chemical structures are adapted from the chemical structures of the pyrethrins and act in a similar manner to pyrethrins. Pyrethroids are modified to increase their stability in sunlight.

Most pyrethrins and some pyrethroid products are formulated with synergists, such as piperonyl butoxide and MGK-264, to enhance the pesticidal properties of the product. These synergists have no pesticidal effects of their own but enhance the effectiveness of other chemicals.

Pyrethrins, a single pesticide active ingredient, contain six components that have insecticidal activity:

pyrethrin 1, pyrethrin 2, cinerin 1, cinerin 2, jasmolin 1, and jasmolin 2

Characteristics of the Ideal Ant Bait

1. Must be a Slow-Acting Toxicant.
2. Must be a Non-Repellent Toxicant.
3. It must be based upon an Ant's Preferred Food Source.

Baits work because they exploit the ants' behavior of sharing food and nutrients with other ants. Passing nutrients from one ant to another is called trophallaxis. If food contains a slow-acting toxicant and the ant does not detect it, the toxicant is passed throughout the colony by trophallaxis, before killing its members, including the queen. Ant baits work only if the ants eat the bait. Eliminate any alternate food sources by keeping counters clean and storing food in sealed containers.

The Keys to a Successful Ant Management Program include the Following Five Steps:
(1) Correcting any conditions conducive to the infestation (unnecessary harborage, sanitation).
(2) Locating and treating existing colonies with Demand, Suspend, Tempo, Delta dust, or Drione.
(3) Servicing the property regularly to detect and eliminate any new colonies.
(4) Application of perimeter treatments with Demand, Suspend, Tempo, or Talstar G.
(5) Application of ant baits inside with Advance Carpenter Ant Bait, Maxforce gradual, Maxforce gel, or Uncle Albert's Gel Bait. Reliance on just one or two of the above steps will generally result in failure to provide any significant relief from interior infestations.

Let's Go into a Little More Detail on Each of the Above:
(1) Correcting Conditions
Eliminate any moisture problems; such as leaks or excessive moisture around the foundation.

Eliminate any food sources, including honeydew associated with aphids. Branches of trees and shrubs need to be kept cut away from the structure.

Cracks in the structure need to be sealed. If possible, a vegetation-free border should be created around the base of the foundation to make the area less attractive to ants and to allow for easier inspection of the foundation. This zone should be free of bark or mulch, and should consist of gravel or small stones. Remove all harborage, such as leaves, trash, mulch, firewood, bricks or lumber.

(2) Locate and Treat Colonies
Drench colonies living in the soil or under items on the exterior with Demand, Suspend, or Tempo. With mulch, be sure to rake it back so you can get good penetration where colonies may be thriving. Follow up with a broadcast application of granule such as Talstar G.

If you know with some certainty where the colony is living inside, then you can treat them directly by drilling a small hole into the wall void at the base (directly above the baseboard) and injecting a dust such as Delta Dust, Drione, or Borid Turbo.

If the colony cannot be located, baits such as Advance Granular, Maxforce Gradual, Maxforce Gel, or Uncle Albert's Gel Bait can be applied to areas where ants are foraging.

(3) Service the Property Regularly
Inspect and service the property regularly to detect and treat any new colonies.

(4) Regular Perimeter Treatments
Treat the outside foundation regularly to establish a barrier that will keep ants away and out of the structure. *Note-* Always inspect thorough before treatment. If you note ants entering the structure from the outside, you may want to consider baiting in this area, as a pesticide may break off or trap the colony inside.

(5) Bait Applications on the Interior
Baits should be employed when inside colonies cannot be located and/or when combined with the strategies already mentioned. Baits such as: Advance Carpenter Ant Bait, Maxforce Granual, Maxforce Gel, Uncle Albert's Gel Bait, or Dr. Moss Liquid Ant Bait can be applied to areas where ants are foraging.
Note: With Dr. Moss Liquid Ant Bait, use the Dr. Moss Liquid Ant Bait Station.

The use of indoor bait stations such as the Ant Cafes will preserve and protect baits.

Use the Crusader to apply your dusts or baits into those tight spots or hard to reach places.

Note: Use only one Crusader for each formulation. You don't want to contaminate your bait with an insecticide.

Regular Inspections
Regular inspections and service are necessary to find and treat new colonies as they move in from neighboring properties. These perimeter treatments can keep the customer’s home or business pest free. We suggest a regular treatment on the exterior with Demand, Tempo, or Suspend**.**

General tips for limiting ant infestations include:
- Eliminate piles of lumber, bricks, or other debris that could serve as a nesting site for ants.
- Keep landscape mulch less than 2 inches thick and at least 12 inches away from foundations.
- Ensure the sprinkler system does not spray directly onto the foundation.
- Seal as many cracks in the building's exterior as possible.
- Keep tree and shrub branches cut away from touching the building.

Consider re-landscaping to avoid using plants that are prone to aphids and similar insects. At the very least, treat such plants for aphids regularly.

Ant Treatment Chemicals – Active Ingredients

In areas of active colonies, treat walls and ceiling voids through cracks and crevices with non-repellent boric acid dust and make bait placements. Keep the ants in the area long enough to get the slow-acting toxicants to the main colony where the workers, larvae and queens are poisoned. (A delayed-action stomach poison is recommended.) Repellent insecticides, such as pyrethrins, will move the colonies, spreading them further throughout the building.

Research has shown that it is best to use bait placement only where active ant trails are found. This ensures feeding, since some ants have not been able to find the bait even when only one inch away from the bait stations. Intersect the ant trail with bait on a cotton swab taken from the station to ensure instant feeding. Bait preference may change during the season due to changing needs of the developing colonies.

An effective bait is a 99 percent boric acid formulation mixed at a 5 percent concentration by weight in mint apple jelly (about two level tablespoons of powdered boric acid per 10 ounces of mint apple jelly). Another bait is 2 percent boric acid and 98 percent light corn syrup.

Methoprene
A commercial bait called methoprene (Pharorid) is marketed for use by pest control operators in a bait that consists of liver, honey, and sponge cake. It is often difficult to use the bait ants prefer; as ants feed on one compound, another compound placed less than 1/4-inch away will be ignored until the ants spill over into the second bait.

Boric Acid
Boric acid and methoprene baits work slowly, sometimes taking 15 to 40 weeks or more before ant eradication. A bait containing hydramethylon (same as in Maxforce roach bait stations) gives quicker results, 2 to 35 days, according to certain pest control operators. Bait stations may include jumbo size plastic drinking straw sections, medicine (pill) dispensing cups, and plastic vial caps and/or drafting (masking) tape.

Placement can be made on the rear lip of kitchen counters, at plumbing pipe-wall junctions, on window sills, behind wall electrical outlets, above door frames, etc., in less accessible areas of pets or young children.

There may be increased or new ant feeding activity during the early part of the baiting program. No other pesticides, heavy-duty cleaners, or paints should be used during the baiting periods to discourage ant feeding.

Bendiocarb
Applications of bendiocarb (Ficam), which is odorless, can give fast eradication of ants if treatments are thorough. Ficam 76 percent WP and 91 percent dust is labeled for licensed commercial and pest control operators. The bait products most recommended for Pharaoh ant control include: (boric acid plus mint apple jelly (Drax), hydramethylnon (Maxforce), methoprene (Pharorid), bendiocarb (Ficam), propoxur (Baygon) and sulfluramid (Pro-Control)).

After bait stations are placed, one will see ants trailing to and from these bait stations. Do not spray or disturb the ants or bait stations. Ants must be allowed to carry the bait back into their nest where the active ingredient in the bait will eliminate the colony.

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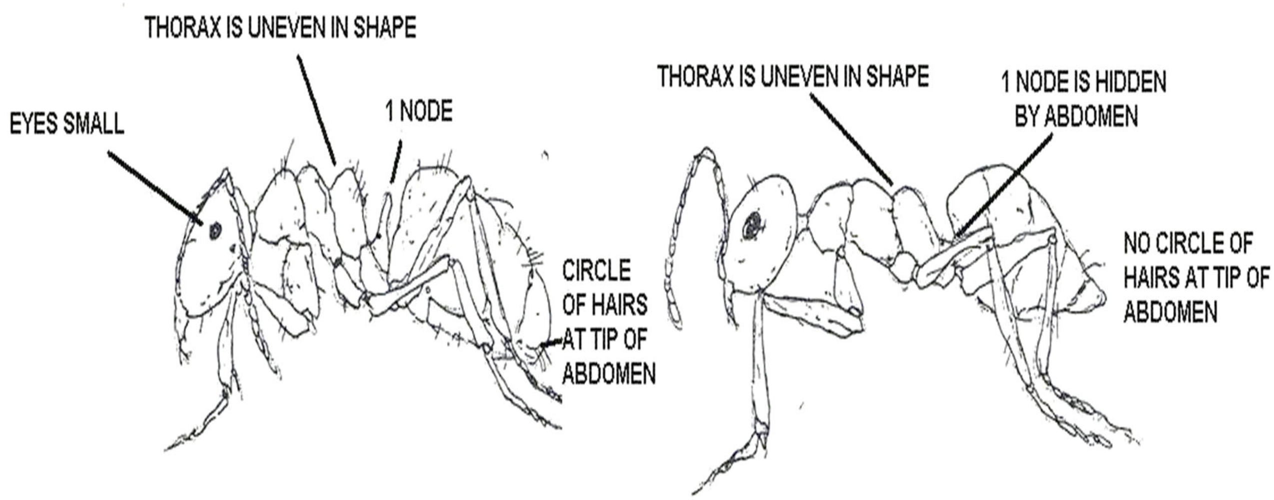

LARGE YELLOW ANT
(Acanthomyops interjectus)

ODOROUS ANT
(Tapinoma sessile)

Ant Predators

Ground beetles, humpback flies, parasitic wasps, praying mantis and the yellow-shafted flicker all dine on ants. Woodpeckers are voracious ant eaters. You may see them also pick up ants in their beaks and crush them on their feathers. What are they doing this for? Crushing the ants' bodies releases tannic acid which in turn protects the bird from parasites!

Here is something interesting: it is said if you take a shovelful of ants from one hill or nest and put it in another ant hill then take a shovelful from that hill and put it where you took the first one the ants will then wage war on one another and do themselves in!

Ant Repellent Plants
Catnip, pennyroyal, peppermint, sage, and spearmint. Tansy which is often recommended as an ant repellant may only work on sugar type ants. These are the ones that you see on peonies and marching into the kitchen.

Warning: You do not want to plant Tansy anywhere that livestock can feed on it as it is toxic to many animals. Do not let it go to seed either as it may germinate in livestock fields.

Organic Ant Barriers
Sprinkle leaves and flowers from sage, mints or tansy around the outside of your house or plants that are bothered by ants. These plants can also be used as a living barrier for ant control, bearing in mind that they are invasive in their growth habit and using cuttings from these plants as a barrier is more effective. We grow tansy in an out of the way place to harvest the cuttings.

- Vinegar sprays in and around the hose foundation will repel ants. Keep way from the soil and concrete. Lemon juice concentrate can also be used: mix 50/50 with water and spray.
- Ants will not walk through a line of talcum powder or chalk dust. Diatomaceous earth may also be used as a barrier in and out of the household.
- Using a silica aerogel/pyrethrum spray applied to the base of plants like eggplants and peppers can control fire ants from girdling the stems and killing the plants. This is a good barrier as it stays "put."
- Caulk all cracks and crevices in the building to deny them access. Be sure to use high quality pure silicone caulking as these are less likely to shrink or crack once applied.
- Distribute cucumber parings as a repellant. Cucumbers contain a compound known as "trans-2-nonenal" that repels ants as well as cockroaches!
- Try sprinkling some of those instant grits around the nests. See what happens!

For fire ants: We recommend Spinosad or try this: Pour half a cup of Epsom salts into the nest and all around it.

- ✓ Sticky barriers like Tanglefoot make an excellent barrier and can be applied to tree trunks to disrupt the ants from farming of aphids. This procedure will naturally biodegrade itself towards the end of the season. **NOTE**: On young trees with smaller trunks or those with thin bark (aspens, birches etc.) do not apply directly to the bark surface. Instead use some thin fabric tied around the trunk with the sticky stuff applied over this. Remove at the end of the season.
- ✓ On smaller plants a bit of petroleum jelly smeared around the base will stop ants immediately.

Direct Controls

- ✓ Douse the nests with boiling water several times. Cruel and can be effective.
- ✓ Dusts such as Silica Aerogel can last a long time. Their mode of action is to dehydrate the ants. They work slowly and are easy to use in tight areas such as cracks or crevices.
- ✓ Make a strong hot water and hot pepper tea. Use the hottest peppers you can find, finely chop them in a food processor, and mix with hot water. Pour directly on the nest.
- ✓ Repeated flooding of the nest every few days using your garden hose can often be enough to get them to relocate. You must be persistent with this method.
- ✓ Use equal parts of sugar and baking powder. Place around ant infested area and nests.
- ✓ Using a sugar soaked sponge works well for light invasions of ants. Use a large sponge with big holes in it. Soak it in a strong solution of sugar water and place it where you want to catch the ants. Rinse the sponge out every day in a container of soapy water. Fix it up with the sugar water again and repeat as often as necessary.
- ✓ Pour apple cider vinegar down entrance holes to the nest.

Last Resorts

- ✓ Pyrethrum mixed with isopropyl alcohol kills ants on contact. Take 16 ounces of ready to use pyrethrum, mix in 1 tbsp. alcohol. Use this as a drench directly on the active nest. Be careful, some states and labels will not allow this mixture.
- ✓ Boric acid: Mix 1 cup of sugar, 4 teaspoons of boric acid and 24 ounces of water in a glass screw top jar. Shake thoroughly until you can see that all the crystals are dissolved. Now put 1 cup of this mixture into a smaller jar which you have filled halfway with loose cotton. Firmly screw the lid back on, seal around the band with weatherproof tape and using an awl punch a few small holes in the center of the lid. Put this near the entrance of the nest or wherever they have made a path to your house. The key is the ants will get into the jar to eat the sugar and return to the nest and pass it on to the rest of the colony. If you find many dead ants by the jar dilute the solution and try again. With a proper mixture the colony may be destroyed in a few weeks. It does take the destruction of the queen to completely eradicate a colony. Keep this away from kids and pets!

These recommendations are provided only as a guide. It is always the pesticide applicator's responsibility, by law, to read and follow all current label directions for the specific pesticide being used. Due to constantly changing labels and product registration, some of the recommendations given in this writing may no longer be legal by the time you read them.

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2017 Changes to EPA's Farm Worker Protection Standard

In late 2015 the Environmental Protection Agency issued the long awaited revision to the Worker Protection Standard (WPS). This law it is now technically active and it will be enforced. Please keep in mind that the WPS covers both restricted use AND general use pesticides. This course is not for worker and/or handler training. Always follow the label and your State Pesticide Agency rules.

This course contains EPA's federal rule requirements. Please be aware that each state implements pesticide regulations may be more stringent than EPA's regulations. Check with your state environmental/pesticide agency for more information.

Signs and Symptoms of Pesticide Poisoning

Recognizing Signs and Symptoms of Poisoning
Anyone who may become exposed to pesticides should be aware of the signs and symptoms of pesticide poisoning. Prompt action during pesticide overexposure can prevent serious consequences. Poisoning signs can be seen by others, for example, vomiting, sweating, or pin-point pupils.

Even with only mild symptoms, a worker can feel uncomfortable. Eyes can water and get red and itchy. Skin can get red bumps and feel itchy.

- Dizziness, faintness • Blurry vision • Vomiting
- Coughing • Fainting • Very bad headaches
- Wheezing or trouble • Drooling from
- Small pupils breathing mouth or nose of the eyes

Severe Symptoms
Some of these symptoms may feel like a cold, flu, or heat exhaustion. Some people may have an allergic reaction to plants, fertilizers, or other chemicals used in agriculture. It is best to see a doctor if any of these symptoms are present.

Very Severe Pesticide Poisoning Can Lead to Death.

Symptoms

- ✓ Are any functional changes in normal condition that can be described by the victim of poisoning, and may include nausea, headache, weakness, dizziness, and others?
- ✓ Anyone who works with pesticides should learn what these signs and symptoms are to prevent serious injury and allow prompt treatment.

Persons who are frequently involved with pesticides should become familiar with these important steps:

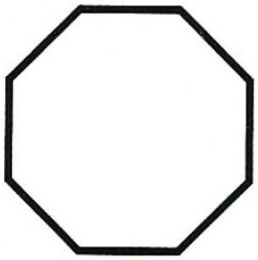
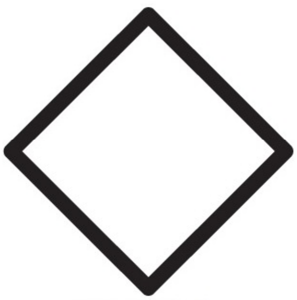
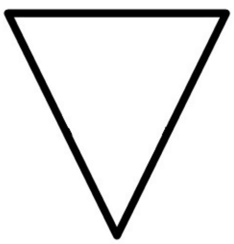
Recognize the signs and symptoms of pesticide poisoning for those pesticides you commonly use or to which you may be exposed.

1. If you suspect a pesticide poisoning, get immediate help from a local hospital, physician, or the nearest poison control center.

2. In a pesticide emergency, identify the pesticide to which the victim was exposed. Provide this information to medical authorities.

3. Have a copy of the pesticide label present when medical attention is begun. The label provides information that will be useful in assisting a pesticide poisoning victim.

4. Know emergency measures you can take until help arrives or the victim can be taken to the hospital. Both first aid and medical treatment procedures are listed on the product label.

SYMBOL	SIGNAL WORD		SYMBOL
	DEGREE OF HAZARD	NATURE OF PRIMARY HAZARD	
 DANGER	**DANGER** LD_{50} Less than 500 mg/kg HIGH TOXICITY REQUIRES: Goggles Respirator Gloves Skin Protection Avoid the Fumes and Mist	**POISON**	
 WARNING	**WARNING** LD_{50} 500 - 1000 mg/kg MODERATE TOXICITY REQUIRES: Goggles Gloves Skin Protection Avoid the Fumes and Mist	**CORROSIVE**	
		FLAMMABLE	
 CAUTION	**CAUTION** LD_{50} 1000 - 2500 mg/kg LOW TOXICITY REQUIRES: Gloves Skin Protection Avoid the Fumes and Mist	**EXPLOSIVE**	

DEGREE OF PESTICIDE RISK AND HAZARD SYMBOLS

Recognizing Common Pesticide Poisonings

All pesticides in a given chemical group generally affect the human body in the same way; however, severity of the effects vary depending on the formulation, concentration, toxicity and route of exposure of the pesticide. It is important, therefore, to know both the type of pesticide you are using and the signs and symptoms associated with poisoning from it.

Signs and Symptoms of Pesticide Poisoning

- ✓ headache, fatigue, dizziness, loss of appetite with nausea, stomach cramps and diarrhea;
- ✓ blurred vision associated with excessive tearing;
- ✓ contracted pupils of the eye;
- ✓ excessive sweating and salivation;
- ✓ slowed heartbeat, often fewer than 50 per minute;
- ✓ rippling of surface muscles just under the skin.

These symptoms may be mistaken for those of flu, heat stroke or heat exhaustion, or upset stomach.

Moderately severe organophosphate and carbamate insecticide poisoning cases exhibit all the signs and symptoms found in mild poisonings, but in addition, the victim:

- ✓ is unable to walk;
- ✓ often complains of chest discomfort and tightness;
- ✓ exhibits marked constriction of the pupils (pinpoint pupils);
- ✓ exhibits muscle twitching;
- ✓ has involuntary urination and bowel movement.

Severe poisonings are indicated by incontinence, unconsciousness and seizures.

The order in which these symptoms appear may vary, depending on how contact is made with the pesticide.

If the product is swallowed, stomach and other abdominal manifestations commonly appear first; if it is absorbed through the skin, gastric and respiratory symptoms tend to appear at the same time. Fortunately, good antidotes are available for victims of organophosphate or carbamate poisoning at emergency treatment centers, hospitals, and many physicians' offices.

As with all pesticide poisonings, time is extremely critical. If a pesticide is swallowed, obtain prompt medical treatment. If a dermal exposure has occurred, remove contaminated clothing, wash exposed skin and seek medical care.

Remember to ACT quickly:

Ask – Ask other workers if they have experienced the same symptoms.

• If others began feeling sick at the same time and have the same symptoms, then the symptoms may be related to a common pesticide exposure. Symptoms of pesticide exposure usually begin only minutes or hours after the initial contact.

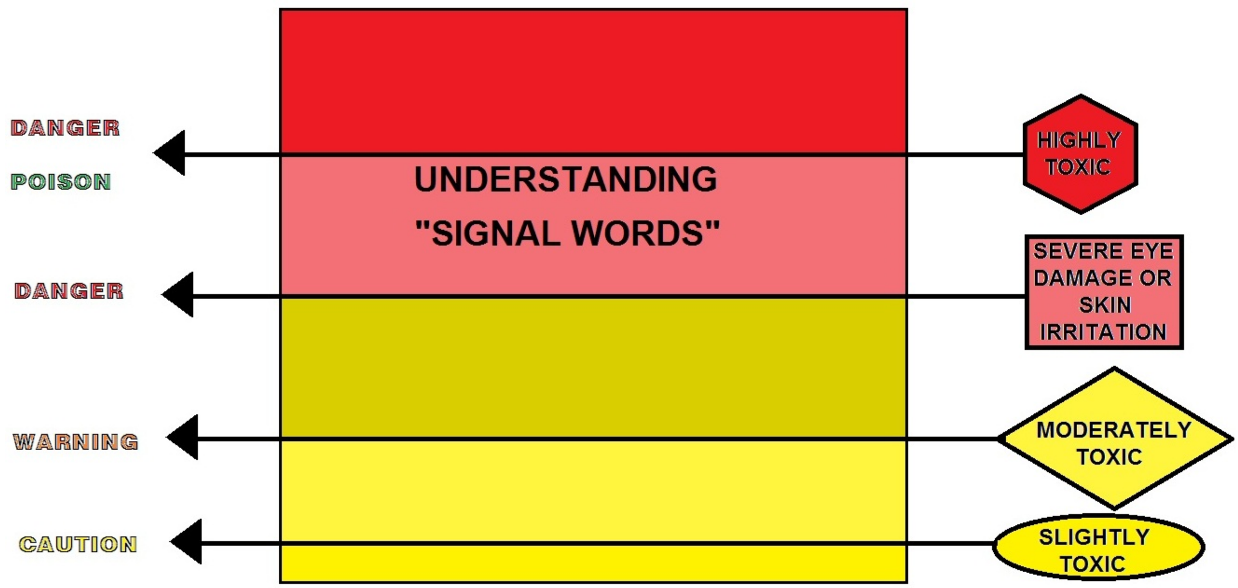
Check – Find out which pesticides were sprayed.

• It is important to know what chemicals were sprayed so your doctor can correctly identify and treat your symptoms. Ask your supervisor or crew leader for this information.

Tell your doctor – Go to a clinic or hospital to seek medical attention.

• If there is even a slight possibility that your symptoms are due to exposure to pesticides,
***tell your doctor this*.**

Note: If you become sick due to hazards at work, you have the right to file a claim for workers' compensation benefits. Your doctor can help you open a claim. These benefits can pay for medical expenses and a portion of wages, if you are too sick to work.



PESTICIDE SIGNAL WORD CHART

Emergency First Aid for Pesticide Injuries

Call a Doctor
First Aid is the initial effort to help a victim while medical help is on the way. Step one in any poisoning emergency is to call an ambulance or doctor. The only exception is when you are all alone with the victim. Then you must see that he is breathing and that he is not further exposed before leaving him to make your phone call. Always save the pesticide and label for the doctor.

While Waiting
Do This for:
Poison on the Skin
- The faster the poison is washed off the patient, the less injury that will result.
- Drench skin and clothing with water (shower, hose, faucet, pond).
- Remove clothing.
- Cleanse skin and hair thoroughly with soap and water. Detergents and commercial cleansers are better than soap.
- Dry and wrap in a blanket.

WARNING: Do not allow any pesticide to get on you while you are helping the victim.

Chemical Burns of the Skin
- Wash with large quantities of slow running water.
- Remove contaminated clothing.
- Immediately cover loosely with a clean, soft cloth.
- Avoid use of ointments, greases, powders, and other drugs in first aid treatment of burns.
- Recognize the signs of pesticide poisoning and know first aid treatment for it.
- Know the importance of a pesticide first aid kit and what it should contain.
- Understand the importance of poison control centers and how to get immediate information on types of poisonings and their treatment.

Poison in the Eye
- It is most important to wash the eye out quickly but as gently as possible.
- Hold eyelids open and wash eye with a gentle stream of clean running water.
- Continue washing for fifteen minutes or more. It is important to use a large volume of water. If possible, at least five gallons should be used to flush the eye properly.
- Do not use chemicals or drugs in wash water. They may increase the extent of the injury.
- Cover the eye with a clean piece of cloth and seek medical attention immediately.

Inhaled Poisons (dusts, vapors, gases)
- If victim is in an enclosed space, do not go in after him unless you are wearing an air-supplied respirator.
- Carry patient (do not let him walk) to fresh air immediately.
- Open all doors and windows.
- Loosen all tight clothing.
- Apply artificial respiration if breathing has stopped or is irregular.
- Keep victim as quiet as possible.
- If victim is convulsing, watch his breathing and protect him from falling and striking his head. Keep his chin up so his air passage will remain free for breathing.
- Prevent chilling (wrap patient in blankets but don't overheat).

- Do not give the victim alcohol in any form.

Swallowed Poisons -- When should you make the victim vomit?
The most important choice you have to make when aiding a person who has swallowed a pesticide, is whether or not to make him vomit. The decision must be made quickly and accurately, by a health care professional because the victim's life may depend on it. Usually it is best to get rid of the swallowed poison fast ...
But you should know this:

- **Never** induce vomiting if the victim is unconscious or is having convulsions. The victim could choke to death on the vomitus.
- **Never** induce vomiting if the victim has swallowed a corrosive poison. Find out what poison the person has ingested. A corrosive poison is strong acid or alkali. The victim will complain of severe pain and will show signs of severe mouth and throat burns. A corrosive poison will burn the throat and mouth as severely coming up as it did going down. Dilute the poison as quickly as possible. For acids or alkalis, use milk or water. For patients one to five years old, use one to two cups; for patients five years and older, use up to one quart. For acids, milk of magnesia may also be used (two tablespoons in one cup of water).
- **Never** induce vomiting if the person has swallowed petroleum products such as kerosene, gasoline, oil, or lighter fluid. Most pesticides which come in liquid formulations are dissolved in petroleum products. The words "emulsifiable concentrate" or "solution" on the pesticide label are signals **NOT** to induce vomiting in the poison victim if he has swallowed the concentrates. Concentrated petroleum products (like corrosive poisons) cause severe burns. They will burn as severely when vomited up. If he has swallowed a dilute form of these formulations, he should be forced to vomit immediately.

How to Induce Vomiting
Do not waste a lot of time inducing vomiting. Use it only as first aid until you can get the victim to a hospital. Make sure the victim is lying face down or kneeling forward while retching or vomiting. Do not let him lie on his back, because vomitus could enter the lungs and do more damage.

- First give the patient large doses of milk or water. One to two cups for victims up to five years old; up to a quart for victims five years and older.
- If victim is alert and respiration is not depressed, give syrup of ipecac followed by one to two glasses of water to induce vomiting. Adults (twelve years and over): 30 ml (two tablespoons); children under twelve years: 15 ml (one tablespoon). Activity hastens the effect of the syrup of ipecac.
- Collect some of the vomitus for the doctor may need it for chemical tests.

The best first aid is to dilute the poison as quickly as possible with milk or preferably with water. It is very important that the victim get to the hospital without delay. Many communities have rescue units with ambulances manned by Emergency Medical Technicians who can communicate with the hospital and can begin treatment in route.

If a rescue unit is not available in your area, you will have to transport the patient. Call the hospital emergency room or poison control center for instructions so that they can prepare for the victim's arrival.

If the poison control center agrees, use activated charcoal as a "sponge" to absorb excess poisons after the instructions for corrosive or noncorrosive poisons are followed.

- Activated charcoal it absorbs many poisons at a high rate. Mix it with water into a thick syrup for the victim to drink. Activated charcoal is available from a drug store.
- Atropine tablets should not be taken in a poisoning emergency. The dose is much too small. Often the victim cannot or should not take oral medicine. The atropine can hide or delay early symptoms of poisoning. The victim may be fooled into thinking he is okay and may even go back to work. It is possible that a doctor may not detect the problem because the symptoms are hidden by the atropine.

WARNING: Atropine can be poisonous if misused. It should never be used to prevent poisoning. Workers should not carry atropine for first aid purposes. It should be given only under a doctor's directions.

Shock
Sometimes poisoning victims go into shock. If untreated or ignored, the victim can die from shock even if the poisoning injuries would not be fatal.

Symptoms

- The skin will be pale, moist, cold and clammy. The eyes are vacant and lackluster with dilated pupils. The breathing will be shallow and irregular. The pulse is very weak, rapid and irregular. The victim may be unconscious or in a faint.
- Unless he is vomiting, keep the victim flat on his back with his legs up
- 1-1 1/2 feet above his head.
- Keep the victim warm enough to prevent shivering. Do not overheat.
- Keep the victim quiet and reassure him often.

WARNING: Never try to give anything orally to an unconscious victim.

Poison Control Centers
Poison control centers have been established to give pertinent information on all types of poisonings, including pesticide poisoning. The applicator should have posted near his phone the telephone number of the nearest poison control center, and his doctor should also have the number available.

EACH PESTICIDE HANDLER EMPLOYEE MUST HAVE AN UNDERSTANDING OF THE FOLLOWING SUBJECT AREAS TO SAFELY USE AND HANDLE PESTICIDES:
PESTICIDE PRODUCT LABELING - Format and meaning of information, such as the precautionary statements concerning human health hazards.
HAZARDS OF PESTICIDES - These are identified in product labeling, Safety Data Sheets (SDS), or PSIS Leaflet (Pesticide Safety Information Series).
PESTICIDE SAFETY REQUIREMENTS AND PROCEDURES - This in regards to regulation, PSIS Leaflets, SDS, Including Engineering Controls, for handling, transporting, storing and disposal of Pesticides.
ENVIRONMENTAL CONCERNS - This addressess the aspect of drift, runoff, and the hazards to Wildlife.
ROUTES OF ENTRY - This area addressess the hazards of which Pesticides can enter the body: Dermal (skin) , Oral (swallowed), Inhalation (breathe in), Ocular (through the eyes).
COMMON SIGNS AND SYMPTOM OF EXPOSURE - Some of the basic symptoms include: Headache, fatigue, weakness, nervousness, nausea, perspiration, eye and skin irritation.
EMERGENCY FIRST AID - Know and understand the basic procedures necessary for first aid concerning exposure to pesticides. This may include basic CPR.
USE AND CARE OF PERSONAL PROTECTIVE EQUIPMENT - Each employee who handles or may have the chance of being exposed to pesticides must have required Personal Protective Equipment available, and each employee must know and understand the proper use and care of this equipment.
THE ITEMS LISTED ABOVE ARE JUST BASICS REQUIRED TO SAFELY HANDLE PESTICIDES

Routine - Emergency Decontamination Procedures

Routine decontamination procedures are things you can do on a daily basis to protect your health and minimize your exposure to pesticides. Wash your hands before eating, drinking, smoking, chewing gum or tobacco, or using the toilet. Wash your hands before touching your eyes or mouth. Wash your hands even if you have been wearing gloves.

Shower or bathe with soap and water immediately after work. Shampoo your hair and put on clean clothes. Also keep your dirty work clothes away from non-work clothes and the family laundry.

Wash your work clothes separately from other clothes before wearing them again. Routine decontamination procedures may help prevent the need for emergency decontamination procedures.

Emergency decontamination should be initiated if a pesticide is spilled or sprayed on your clothing or skin. Stop work and leaving the work area.

Remove the pesticide contaminated clothing right away and wash immediately in the nearest clean water.

Wash the skin with lots of clean water and soap to prevent the pesticide from being absorbed through the skin and into the body.

Your supervisor or others who are involved in the decontamination process should protect themselves from exposure before they assist you. If medical attention is not necessary, shower, shampoo, and change into clean clothes before resuming work.

Eye Flushing Procedure
To quickly decontaminate your eyes, use an eyewash fountain or pour water into your eyes, holding the eye open while flushing the pesticide out. Move your eyeball and eyelid and flush for at least 15 minutes. Get medical help immediately.

You will be provided with an ample supply of soap, water, and clean towels for both routine washing and emergency decontamination if the areas where you work have had pesticides applied in at least the last 30 days.

These supplies will be located within ¼ mile of where you are working.

§170.509 Decontamination and Eye Flushing Supplies for Handlers

(a) *Requirement.* The handler employer must provide decontamination and eye flushing supplies in accordance with this section for any handler that is performing any handler activity or removing personal protective equipment at the place for changing required by §170.507(d)(9).

(b) *General conditions.* The decontamination supplies required in paragraph (a) of this section must include: at least three gallons of water per handler at the beginning of each handler's work period for routine washing and potential emergency decontamination; soap; single-use towels; and clean clothing for use in an emergency. The decontamination and eye flushing supplies required in paragraph (a) of this section must meet all of the following requirements:

(1) *Water.* At all times when this section requires handler employers to make water available to handlers for routine washing, emergency decontamination or eye flushing, the handler employer must ensure that it is of a quality and temperature that will not cause illness or injury when it contacts the skin or eyes or if it is swallowed. If a water source is used for mixing pesticides, it must not be used for decontamination or eye flushing supplies, unless equipped with properly functioning valves or other mechanisms that prevent contamination of the water with pesticides, such as anti-backflow siphons, one-way or check valves, or an air gap sufficient to prevent contamination.

(2) *Soap and single-use towels.* The handler employer must provide soap and single-use towels for drying in quantities sufficient to meet the handlers' needs. Hand sanitizing gels and liquids or wet towelettes do not meet the requirement for soap. Wet towelettes do not meet the requirement for single-use towels.

(3) *Clean change of clothing.* The handler employer must provide one clean change of clothing, such as coveralls, for use in an emergency.

(c) *Location.* The decontamination supplies must be located together outside any treated area or area subject to a restricted-entry interval, and must be reasonably accessible to each handler during the handler activity. The decontamination supplies must not be more than 1/4 mile from the handler, except that where the handler activity is more than 1/4 mile from the nearest place of vehicular access or more than 1/4 mile from any non-treated area, the decontamination supplies may be at the nearest place of vehicular access outside any treated area or area subject to a restricted-entry interval.

(1) *Mixing sites.* Decontamination supplies must be provided at any mixing site.

(2) *Exception for pilots.* Decontamination supplies for a pilot who is applying pesticides aerially must be in the aircraft or at the aircraft loading site.

(3) *Exception for treated areas.* The decontamination supplies must be outside any treated area or area subject to a restricted-entry interval, unless the soap, single-use towels, water and clean change of clothing are protected from pesticide contamination in closed containers.

(d) *Emergency eye-flushing.* (1) Whenever a handler is mixing or loading a pesticide product whose labeling requires protective eyewear for handlers, or is mixing or loading any pesticide using a closed system operating under pressure, the handler employer must provide at each mixing/loading site immediately available to the handler, at least one system that is capable of delivering gently running water at a rate of least 0.4 gallons per minute for at least 15 minutes, or at least six gallons of water in containers suitable for providing a gentle eye-flush for about 15 minutes.

(2) Whenever a handler is applying a pesticide product whose labeling requires protective eyewear for handlers, the handler employer must provide at least one pint of water per handler in portable containers that are immediately available to each handler.

If Pesticides Are Spilled on the Body

If pesticides are spilled or sprayed on the body to use decontamination supplies to wash immediately or rinse off in the nearest clean water including streams, springs, lakes, or other sources if they are more readily available than decontamination supplies…

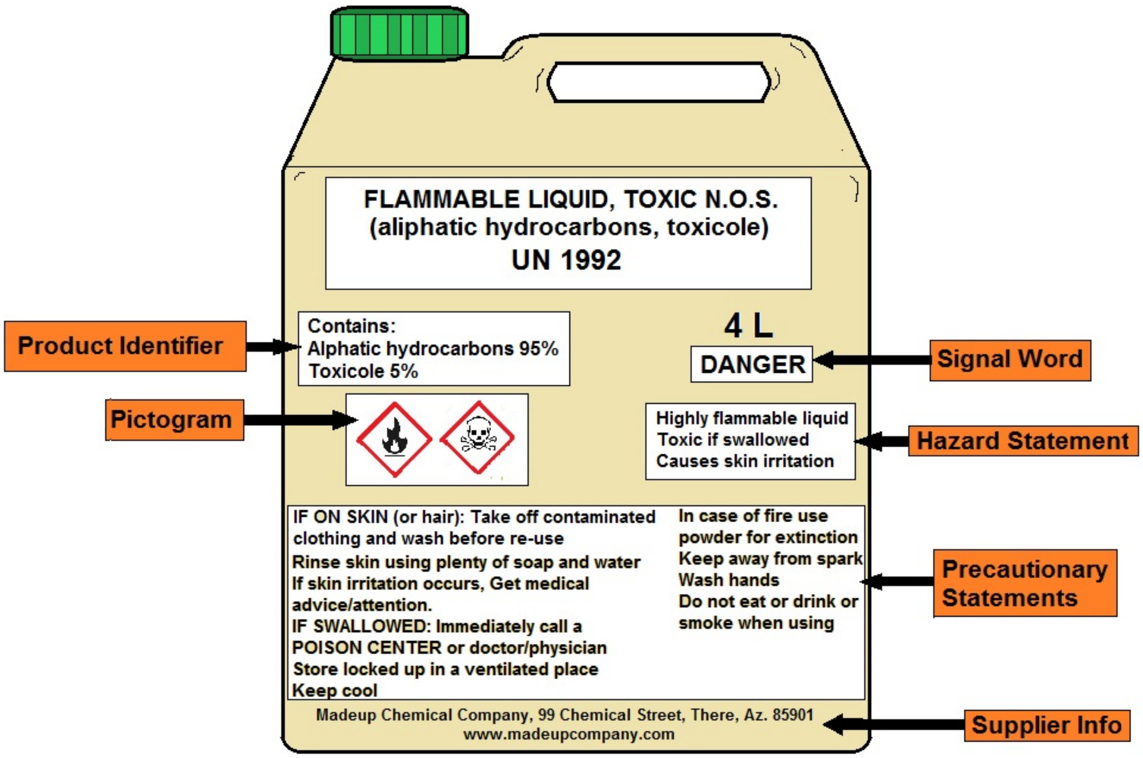
What should I do if I am exposed to a pesticide?
1. Minimize further exposure.
- If a pesticide is splashed on your clothing remove the clothes as soon as possible and later wash the clothes separately from other clothes.
- If pesticides are on your skin wash with soap and water for at least 15 minutes.
- For pesticides in the eyes, rinse your eyes with water for at least 15 minutes.
- If you accidentally eat or drink a pesticide, read the label to see if vomiting should be induced. If you feel a burning sensation, rinse your mouth with water and dilute the poison by drinking milk or water.
- If you have inhaled a pesticide, leave the area and seek fresh air. Follow re-entry directions on the product label.

2. If you begin to have symptoms, such as feeling dizzy, having skin irritation/pain, feeling sick to your stomach, or vomiting, call the **Poison Control Center (PCC) at 1-800-222-1222.** The PCC has trained professionals to answer the phone 24 hours a day. They can give information on pesticides and treatment information for those that need it. Help is available in several languages.

3. If advised by the PCC, or if unable to reach a PCC, get medical help from your doctor or hospital emergency room.

Bring with you:
- labels of all pesticides you were exposed to, if available; and/or
- records telling what and how much was sprayed from the person or company that sprayed, if available.

In late 2015 the Environmental Protection Agency issued the long awaited revision to the Worker Protection Standard (WPS). This law it is now technically active and it will be enforced. Please keep in mind that the WPS covers both restricted use AND general use pesticides. This course is not for worker and/or handler training.



PESTICIDE LABEL DIAGRAM

Topic 2 - 2 Node Ant Identification and Control Post Quiz
Answers in Rear after Glossary

Ant Bait Treatments
1. If the nest cannot be located, baits are not effective alternative. Baits work by combining an attractive food source with a fast-acting toxicant.
True or False

2. A delayed toxicant is critical because it allows the ants to forage normally for days or even weeks. During that time, ants consume the bait and return to the nest to share the bait with the rest of the colony.
True or False

Key
3. Applied properly and using a fresh bait product, a broadcast application will give _____________ percent control, rarely 100%.

Locate and Treat Colonies
4. Drench colonies living in the soil or under items on the exterior with?

Nest Treatments
5. Dominion 2L and Termidor can be used inside. Like newer insecticides, non- repellent insecticides can be smelled, tasted, or even felt by pests. So they crawl through the treated area, not knowing that by ingesting treated materials or merely contacting the insecticide, they'll die.
True or False

6. Carpenter ants usually do not make nest in healthy wood, but tunnel wood that has become wet and started to decay. The larger Carpenter ants are about 3/8 to 1/2" long. They may be black or red. Unlike other home-inhabiting ants, the larger carpenter ants cause structural damage to wood by excavating and nesting inside wood structures.
True or False

7. One effective method to treat carpenter ants are either by baiting, placing the recommended carpenter ant baits listed below one their trails or the use of a non-repellent insecticide inside called Termidor or equivalent chemical.
True or False

Pesticide Poisoning Symptoms
8. Recognize the ____________________of pesticide poisoning for those pesticides you commonly use or to which you may be exposed.

9. If you suspect a pesticide poisoning, get immediate help from a local hospital, physician, or the?

10. Know emergency measures you can take until help arrives or the victim can be taken to the hospital. Both first aid and medical treatment procedures are listed on the?

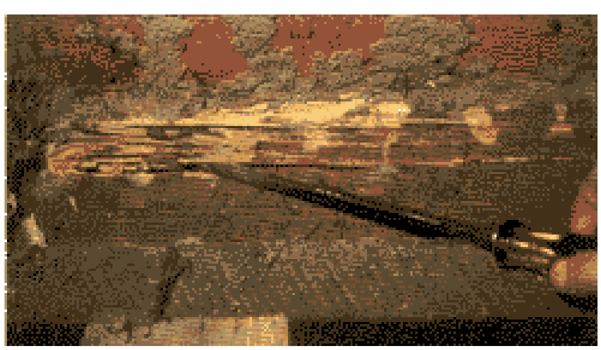
Topic 3 – Termite Introduction

Topic 3 - Section Focus: You will learn the basics of termites, including the life cycle, behavior and related scientific information. At the end of this section, you will be able to understand and describe general information about termites, including the life cycle and related information. There is a post quiz at the end of this section to review your comprehension and a final examination in the Assignment for your contact hours.

Termites
In the US, we primarily have four species of termites, Subterranean (Subs), Drywood, Dampwood and Formosan (FST). Formosan are a new invasive species. We will examine these species, ants and other wood destroyers in detail. There are about 2,500 termite species in the world. North America has 42 different termite species, most of these are located in the southeast USA. Alaska is the only state without termites. Incredibly, Florida's eastern subterranean termite colonies have about 250,000 members, but can have 1 million or more. An average termite colony eats about 1 cubic foot of wood a year. That amount may seem small, but generally speaking, homeowners are unaware of damage for many years. The termite queen can lay up to 2,000 eggs per day and live as long as 50 years.

Termite damage to residential and commercial buildings in the U.S. costs more than $1 billion annually. This amount does not include the cost of termite control. Subterranean termites, the most destructive of all termite species, account for 95% of the damage. Two subterranean termite species, Reticulitermes flavipes (reference Kollar) and R. tibialis Banks, are commonly found in United States. Control of these termites' costs more than $5 million each year and is the reason you are studying this course.

Subterranean(Subs) worker termite. Subterranean termites' mudtube (on glass surface).



Using a screwdriver to probe and examine termite damage, Subs will go with the grain.

Feeding Habits
Termites feed primarily on wood and wood products containing cellulose. Termites have special protozoa (microorganisms) in their intestine that provides enzymes to digest cellulose. This relationship is beneficial to both species, since the protozoans cause no harm and are provided with food and a protected environment by the termites. There is no way that these insects can live without these protozoa, and no way for these bacteria to survive without the termites.

Although termites are soft-bodied insects, their hard, saw-toothed jaws work like shears and can bite off extremely small fragments of wood. Termites often infest buildings and cause damage to lumber, wood panels, flooring, sheetrock, wallpaper, plastics, paper products, and fabric made of plant fibers. Termites attack flooring, carpeting, artwork, books, clothing, and furniture. The most serious damage involves the loss of structural strength. Most termites do not attack live trees, except for the Formosan and Dampwood termite. Dampwood prefer to feed on live trees – but wood that is under ground level notably citrus.

General Colony Information
There are two basic concepts of were the colony is located. Most of the time and for most of the termite species the colony is below ground.

Below Ground Termite Colonies
Subterranean termites are ground-dwelling social insects living in colonies. The two species of Subs found in United States have similar habitats. These termites have the ability to adjust the depth of their colony (nest) in soil depending on temperature and moisture requirements. The colony may be up to 18-20 feet deep in the ground. The ground serves as a protection against extreme temperatures and provides a moisture reservoir. Termites reach wood or cellulose materials above ground by constructing and traveling through earthen (mud) tubes. It takes about 4 to 5 years for a colony to reach its maximum size and it may consist of 60,000 to 200,000 workers.

Above Ground Termite Colonies
Drywood termites do not need a connection to soil and there is no soil in their feeding galleries. They do not build mud tunnels; they construct large, irregular galleries that run across and with the wood grain, with a very smooth, clean, and sandpaper-like appearance.

These galleries are connected by openings small enough for one termite to pass through. The sure sign of drywood termite feeding is their fecal pellets that are ejected from the galleries via kick-out holes, often found right below the damaged wood. These pellets are quite unique and are hard, elongated-ovals with rounded ends, and have six concave sides.

We will cover this more in detail in the inspection portion of the course.

Caste Definition: A group of insects with a specific morphology and function within a colony of social insects.

Most termite species have four castes, King and Queen (reproductives), Soldiers, Workers and Nymphs. There is an exception to this system; the Nevada dampwood termites have three primary castes: nymphs, reproductives and soldiers.

Reproduction

Generally speaking, there are minor differences with the species, in spring and fall, the winged males and females emerge from their parent colonies to form new ones. This activity is called swarming. These winged reproductives are dark brown to brownish black and have two pair of nearly equal size semitransparent wings extending well beyond the body.

The swarmers are weak flyers and, unless aided by wind, fly only short distances. Many of them are devoured by birds, spiders, ants, and other predators.

Survivors return to the ground and shed their wings. The wingless males and females pair off (male following female in tandem) until they find a source of wood and moisture in the soil. They dig soil near wood, enter the chamber and seal the opening. After mating, the queen begins laying eggs. The royal queen is known to survive up to 50 years in some termite species and others up to an average life span of 25 years. We will cover this later in the different species differences.

Worker Solider Reproductive or possible Queen

Eggs

Generally speaking, the fertilized Sub female (queen) usually deposits 6 to 20 eggs during the first six months following the swarming flight and she may lay more than 60,000 eggs in her lifetime. Eggs are yellowish white and hatch after an incubation period of 50 to 60 days.

Workers

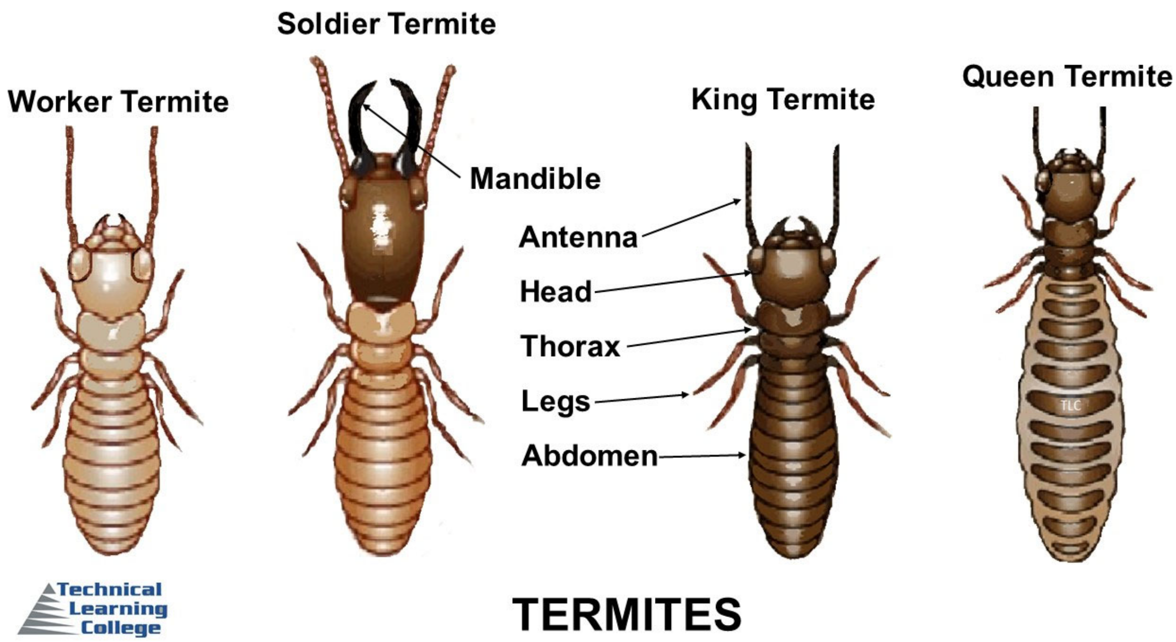
The first broods of newly hatched nymphs (young termites) generally develop into workers. Full-grown workers are soft-bodied, wingless, blind, and creamy white. In early stages, they are fed predigested food by the king and queen. This first feeding also provides the bacteria to help these creatures digest their food. Once workers are able to digest wood, they begin providing food for the entire colony. At this time, the king and queen cease feeding on wood. The workers undertake all the labor in the colony such as obtaining food, feeding other caste members and immatures, excavating wood for chambers, and constructing tunnels. Workers mature within a year and live from 3 to 5 years.

Soldiers

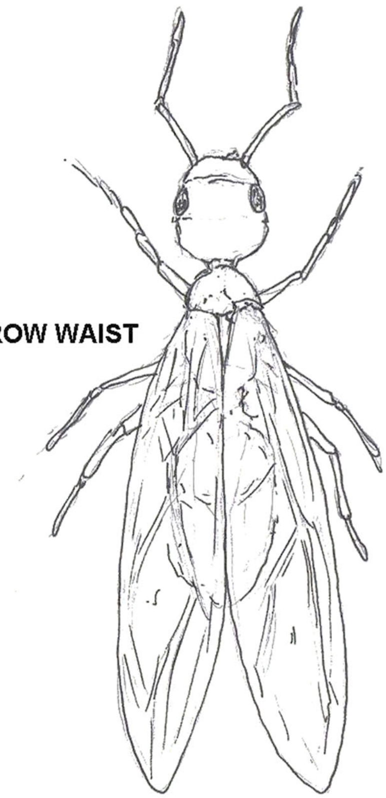
Generally speaking, there are minor differences with the species Soldiers are creamy white, soft-bodied, wingless, and blind. The head of the soldier is enormously elongated, brownish, hard, and equipped with two strong jaws. Soldiers must be fed by workers as they are incapable of feeding themselves. They are less numerous than workers and their sole function is to defend the colony against invaders such as ants. Soldiers mature within a year and live up to 5 years.

Sub Soldier

Flying ants and swarming termites are often difficult to distinguish when these insects are seen around residential and commercial buildings. The main enemy of termites are Ants and the Soldiers can defend against a small number of Ants.

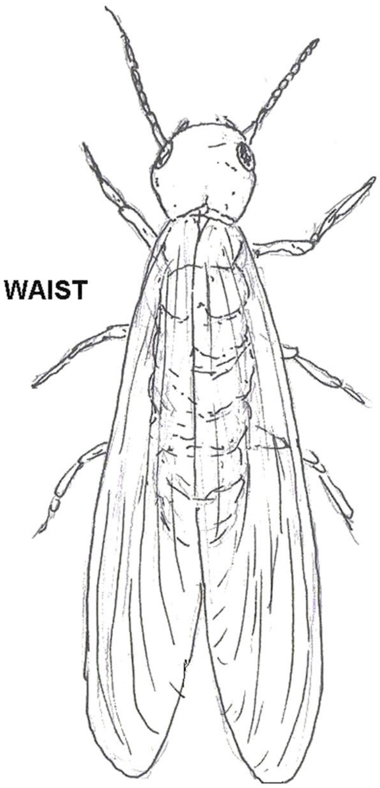


Characteristics	Ants	Termites
Active Reproductives	Queen(s)	Queen and Kings
Antennae	Bent or “elbowed	Straight, beaded
Wings	Hind wings are shorter than its front forewings	Equal size and shape
Parthenogenesis	All Species	Never
Larval Stage	Yes	No
Eye Sight	Most Species	Workers are blind
Build Earthen "Ant Nest"	Rarely	Most Species
Carnivorous	Most Species	Very few species
Grow Fungus "Gardens"	Very few Species	Most Species



WINGED ANT

FRONT WINGS LONGER THAN BACK
(1/2 inch IN SIZE)

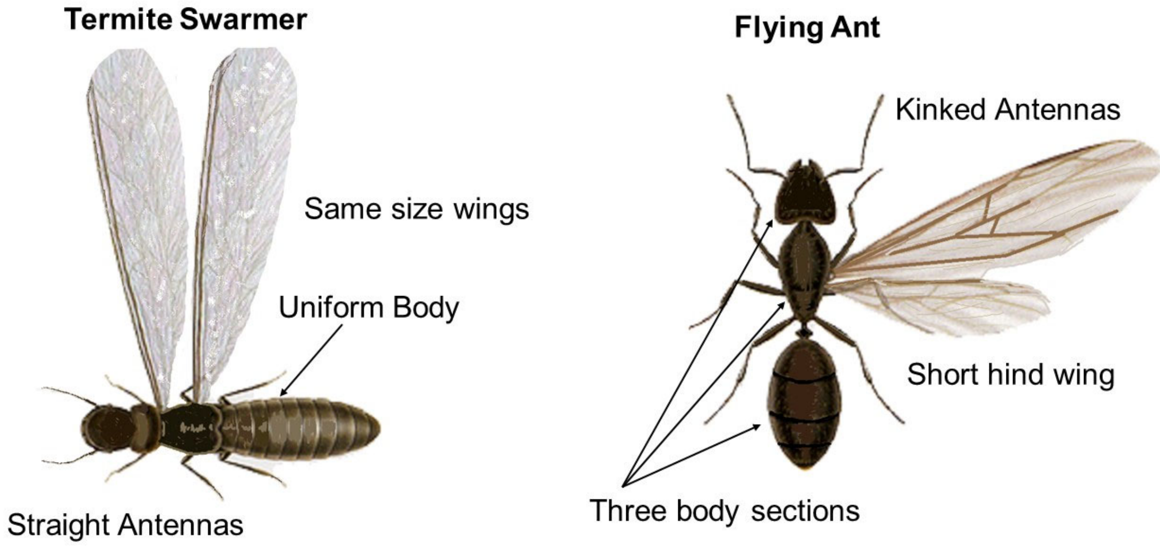


WINGED TERMITE

BOTH PAIRS OF WINGS SAME SIZE
(1/2 inch IN SIZE)

Differences Between Ants and Termites

Body shape: A termite has no "waist," instead, its body is more rectangular, without any narrowing in the center. In contrast, the carpenter ant has a very well-defined narrow, constricted waist.
Antennae: An insect's feelers can say a lot about the insect, too. A termite has straight, beaded antennae, meanwhile, a carpenter ant's antennae are bent or "elbowed."
Wings: Both insects are winged creatures and each has four wings. A termite has wings that are of equal size and shape and its wings are much longer than its body. A carpenter ant's back, hind wings are shorter than its front forewings and the wings do not look unusually long or disproportionate to its body. Another thing with termites is that their wings are not as durable as ants. The wings of the termite fall off easily. The loose wings can often be seen near the opening of a termite nest and can be used to identify a termite infestation.
Color: Ant workers are reddish or dark-colored and are frequently seen in the open foraging for food. Termite workers, by comparison, are transparent, light or creamy white in color, and they avoid light. Termites are rarely noticed unless their nest is disturbed.



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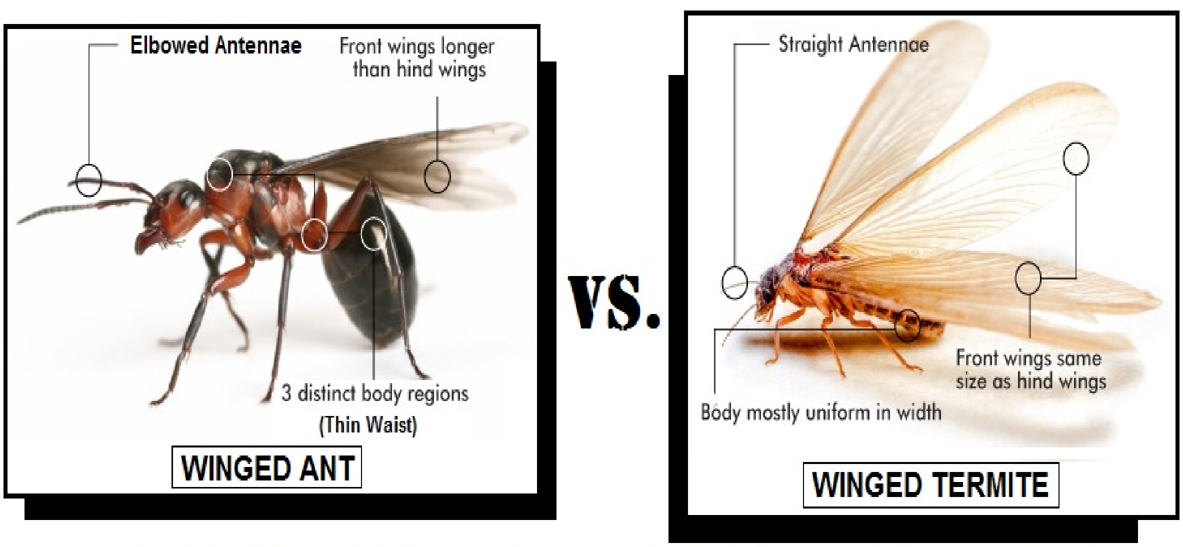
SWARMER TERMITE & FLYING ANT



WINGED TERMITE / WINGED ANT COMPARISON

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Termite Life

More on Reproduction
The female (queen or winged reproductive) assumes a "*calling*" position with her abdomen elevated at a right angle to the rest of her body. She releases a chemical messenger (pheromone) which attracts nearby males. Once a male encounters a calling female, she moves off. He follows close behind and they search for a suitable site for the establishment of a nest. As soon as the pair has located a suitable site, they excavate (with their jaws) a small chamber large enough for the two of them and then seal the entrance. Mating usually occurs within a few hours to weeks after the pair becomes established.

The single female cannot start a new colony on her own. Establishment of a colony is dependent upon the survival of both sexes in the nest site and that she has successfully mated. The pair continues to live together for life, and they usually mate periodically. The first eggs are laid within one to several weeks after mating, depending on the nutrition available to the female. When the first eggs hatch, the new nymphs are cared for by the young pair. After two molts, the nymphs assume their role as workers and begin to feed and care for the original pair.

Development of the Colony
Development of the colony is very slow for several years. Eggs are not deposited continuously. After the first group of eggs has been laid, there is a period of several months before another group is laid. This process continues for several years. As the young queen matures, she lays a greater number of eggs, and her abdomen becomes enlarged from developing eggs. Eventually, a point is reached where the colony size stabilizes. That is, the queen has reached maximum egg production, and the loss of older individuals by death or swarming is approximately the same as the number of new individuals produced each year.

As the colony becomes mature, a greater number of swarmers are produced each year. It requires a minimum of 3 to 4 years--and as much as 8 to 10 years--for a colony of our native subterranean termites to become large enough and strong enough to start dispersal flights.

Swarming
When swarming occurs in a relatively new structure, it is because it was built over or near a strong colony that was not severely damaged during the construction process. Termites derive food from wood and other cellulosic materials. Again as earlier, in nature, they feed exclusively on wood, primarily digesting out the cellulose and passing most of the remaining components as waste.

In man-invaded environments, termites attack many additional products and commodities. They still depend primarily on cellulose for their nutrition, but will damage many materials they encounter. Damaged materials may include plastics, rubber, asphalt, metal, mortar and others. Wood products like paper are favorite foods of termites because they are nearly pure cellulose. Cotton, burlap and other plant fibers are actively consumed by termites as well.

Fungi
Fungi also play a primary role in termite nutrition. Certain wood decay fungi are highly attractive to termites. Partially decayed wood is more easily digested by termites, and the fungus provides a needed source of nitrogen. Ultimately, wood-destroying fungi exhaust the nutritive value of wood for termites, and extensive decay in wood is of no benefit to foraging termites. Conversely, when termites attack wood, they usually bring fungus spores on their bodies. When water or other liquid reaches the damaged wood, it is more easily trapped.

Moisture
Moisture is vital to the survival of termites. Subterranean termites obtain most of their moisture from the soil. They maintain contact with the soil in order to survive. The type of soil has a great effect on the ability of subterranean termites to flourish. They generally prefer sandy soil over a clay base. They can and do survive in many other types of soil, however.

Tolerances
Generally speaking, most termite species have very little tolerance to dry conditions, or extremes of hot and cold. But they often must forage far, sometimes above ground, from their initial workings to find food. They move underground through tunnels. Whenever the termites leave the confines of the soil or the wood in which they are feeding, they construct shelter tubes in which to move from the soil to the wood or the above-ground nest.

Subterranean Termites
When subterranean termites invade the wood of a structure that is separated from the soil by intervening concrete, masonry or other impervious material, they construct shelter tubes (mud tubes) over the surface to the wood. Periodically, they return to the moist galleries.

Contrary to published reports, shelter tubes do not necessarily conduct moist air from the soil to the wood. Shelter tubes also provide some protection from air movement and prevent excess water loss. The primary function of shelter tubes probably is protection from natural enemies. Once termites have established contact with wood above ground and feeding progresses some distance from the initial shelter tunnel, they often will drop shelter tubes straight down from the wood. Evidence of tube building will be found directly below a suspended tube.

Castles
Under certain conditions, a fourth type of tube is constructed. Called swarming tubes or swarming "*castles*" they are constructed as flight platforms for swarmers and they have many turret-like projects and flattened horizontal branches that vaguely resemble castle towers. They usually are constructed on the ground to a height of 4 to 8 inches, but sometimes are found projecting from heavily infested wood above ground.

When swarmers are leaving the colony via these tubes, or directly through a hole in wood or soil, the openings are heavily guarded by soldiers and workers. The amount of damage that an infestation of subterranean termites might inflict on a structure depends on many factors. The number and size of the attacking colonies and the quality of the environmental conditions (including the wood) are the most important.

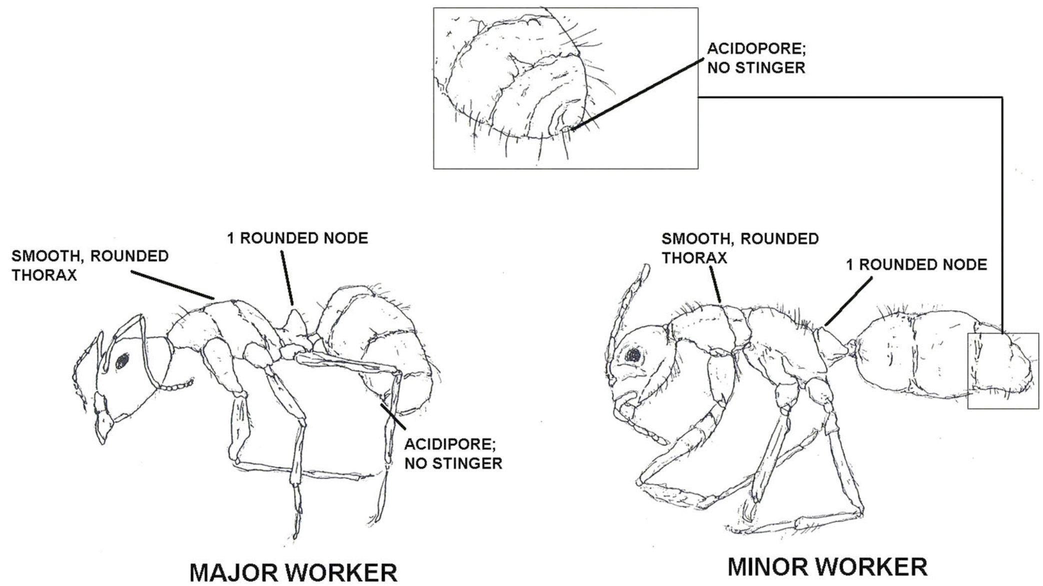
Damage usually starts at the mudsill in houses built over a crawl space and with the sole plates of those houses built on concrete slabs. Given enough time, subterranean termites will extend the damage into the wooden floor members, the interior trim and furnishings, and into the walls up to the roof timbers.

Severe Damage
Severe damage by subterranean termites is not likely to occur in the first 8 or 10 years after construction. If treatment is undertaken with the first evidence of infestation, very little serious structural damage is ever likely to occur. Houses should be carefully inspected at least once a year in all regions. This will allow detection before damage is a problem. Should *evidence of termites be found, there is no cause for extreme alarm or undue haste.* Treatment within 3 months is highly recommended.

Communication in the Colony
1. Termites primarily communicate via pheromones. Each colony develops its own characteristic odor. Any intruder is instantly recognized and an alarm pheromone is released that triggers the soldiers to attack the intruder. If a worker finds a new source of food, it recruits others to that food source by laying a chemical trail. The proportion of castes in the colony is also regulated chemically. Again, nymphs can develop into workers, soldiers, or reproductive adults, depending on colony needs.
2. Sound is another means of communication. Soldiers and workers can bang their heads against tunnel walls. The vibrations are perceived by other termites in the colony and serve to mobilize the colony to defend itself.
3. Mutual exchange of foods enhances recognition of colony members.

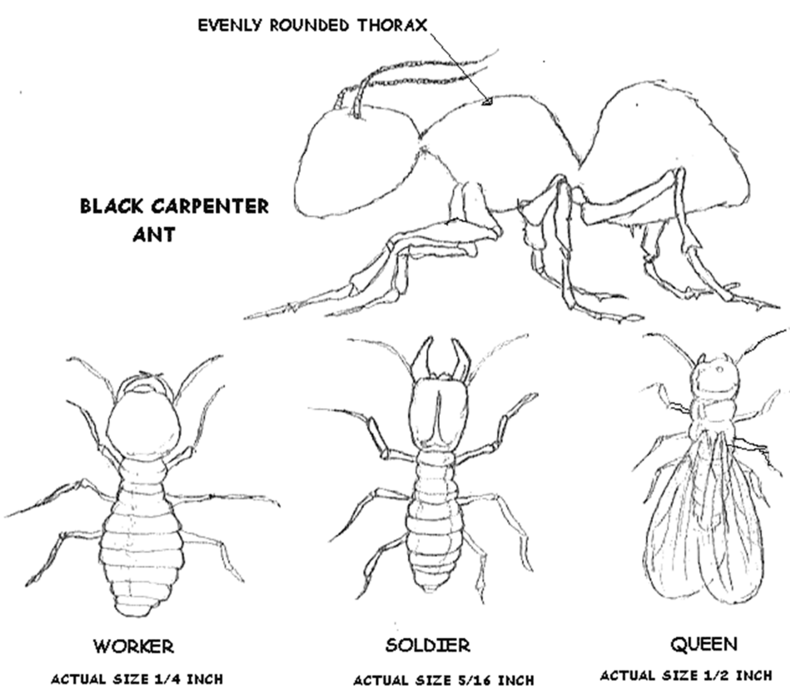
Winged dampwood termite Alate. Winged "sub" Alate.

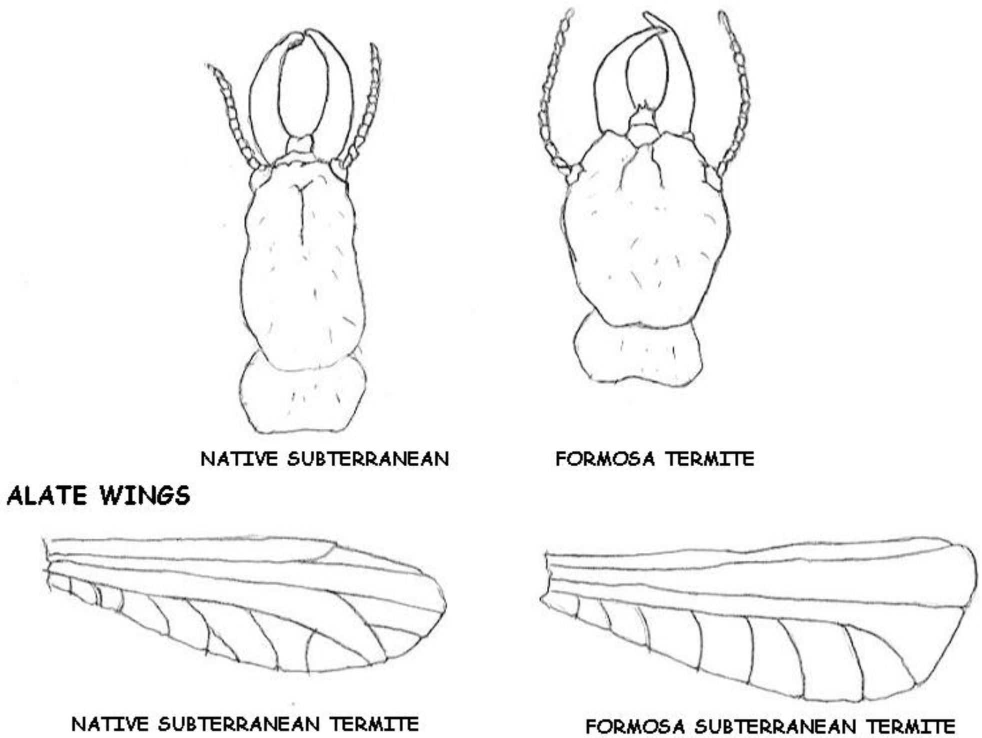
Termite gallery structure or what humans call “serious home damage”.



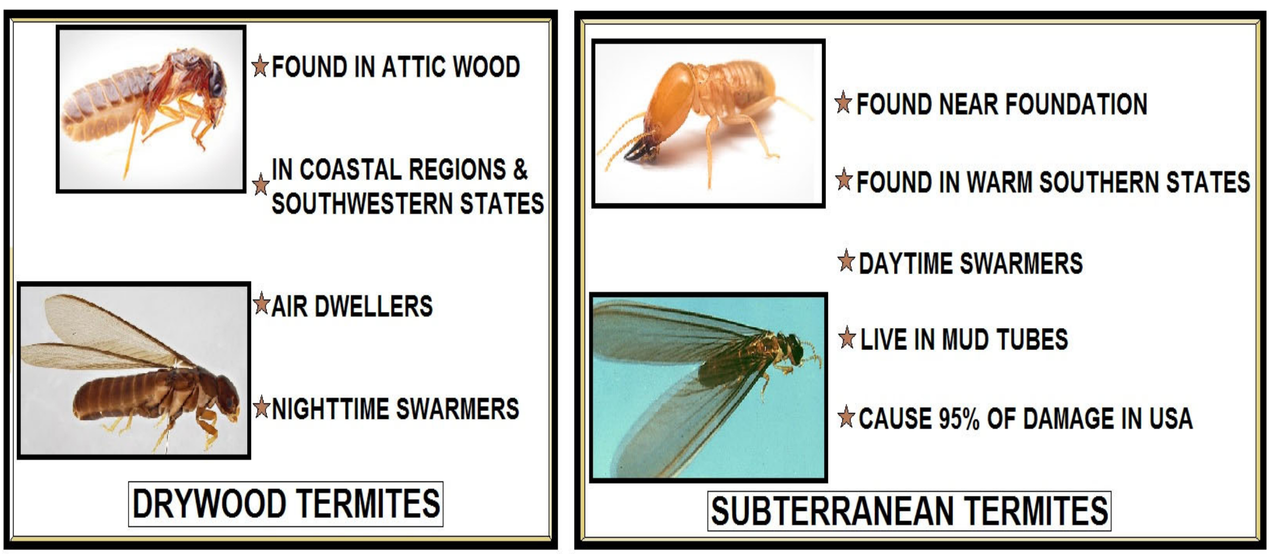
CARPENTER ANT

Carpenter Ant Identification: If you tear the legs off an ant, you'll have a snowman. Not so with a termite**,** you'll have a head and a long body. Termite swarmers have straight, bead-like antennae; a thick waist; and two pair of long, equal-length wings that break off easily. Winged termites can be differentiated from winged ants, which have elbowed antennae, a constricted waist, and two pair of unequal-length wings (forewings are larger than hind wings) that are not easily detached. Ants also generally are harder-bodied than termites.

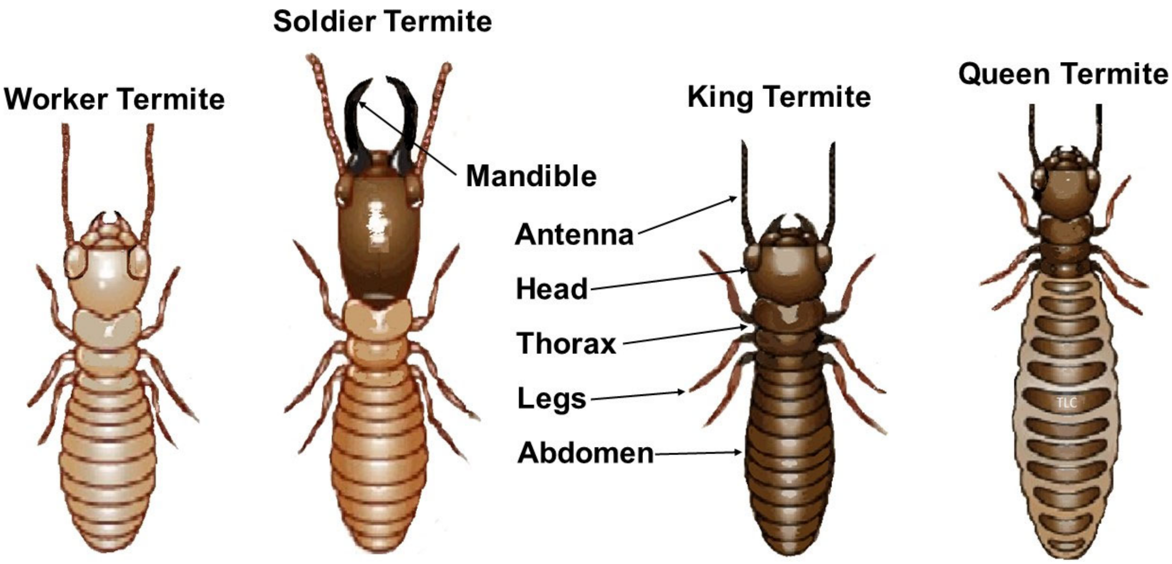




TERMITE SOLDIER DIAGRAM



DRYWOOD / SUBTERRANEAN TERMITE COMPARISON



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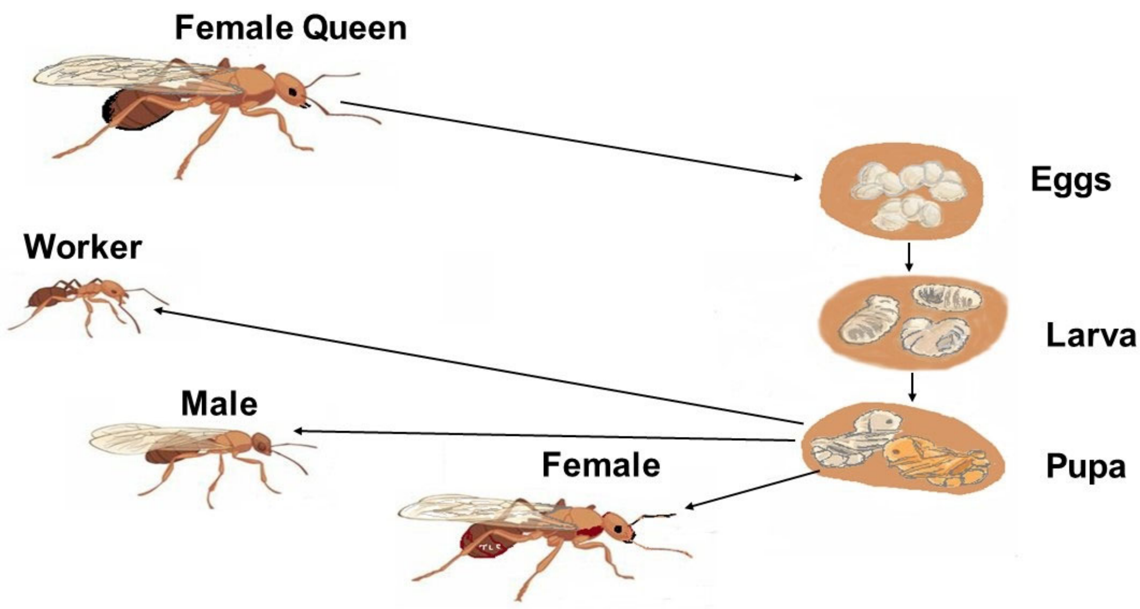
TERMITES



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ANT LIFE CYCLE

Detection of Termites Sub-Section

It is important for homeowners to recognize the signs of a termite infestation. Some termites, like drywood are very difficult to locate. Most termites may be detected by the sudden emergence of winged termites (alates or swarmers), or by the presence of mud tubes and wood damage. We tend to think of termites as feeding/injuring wood only. Termites actually feed on almost anything that contains cellulose (the main component of wood), including wood paneling, paper products, cardboard boxes, art canvases, the paper covering of sheetrock, carpeting, etc. While foraging and feeding, they may tunnel through non-cellulosic materials, such as plastic and foam board.

According to some research, a colony containing 60,000 workers could consume the equivalent of one foot of a 2" x 4" piece of lumber in slightly over 5 months and 1 cubic foot of wood in a year. In reality, the amount of damage that termites cause depends on many factors. In areas with cold winter temperatures, termite activity (and feeding) usually declines, but does not necessarily stop. From a practical perspective, serious termite damage usually takes about 3-8 years.

Look for these signs of termite feeding:

- Wood that sounds "hollow" when it is tapped with the handle of a screwdriver.
- Soft wood that is easily probed with a knife or screwdriver.
- A thin gritty gray-brown film on the surface of damaged material.
- There are electronic devices that work with smart phones that can see inside walls.
- There are flexible cameras that can probe into termite damage.

There is no accurate method for determining the age of recently discovered damage. You need some reference point, i.e., some point in time when it was known that there was no damage to this particular wood. This is one reason why annual inspections (and keeping your records of these inspections) are invaluable. These inspections do not guarantee that there is no damage in visually-inaccessible areas, such as inside walls. However, they can reveal conditions that might suggest that damage does exist.

Necessary Inspection Equipment

- Flashlight
- Probe “Screwdriver”
- Ladder (Termites forage attics also)
- Pencil and Graph paper
- Magnifying Glass
- Digital photograph device like a smart phone

Required Inspection

By state law, the minimum requirement for termite inspections includes visual searches of accessible areas. However, detection of difficult-to-find infestations may require removing walls, paneling, and stucco, as well as using ladders and scaffolds.

Read the pesticide product label - The label tells you exactly how the product is to be used and provides information on potential risks. If the label does not include directions to control termites and protect the structure, then the product is not intended to protect the structure against termites and should not be applied. If you wish to see a copy of the product label, ask the company representative for a copy. Always be prepared to provide a copy of the label information to the business or homeowner.

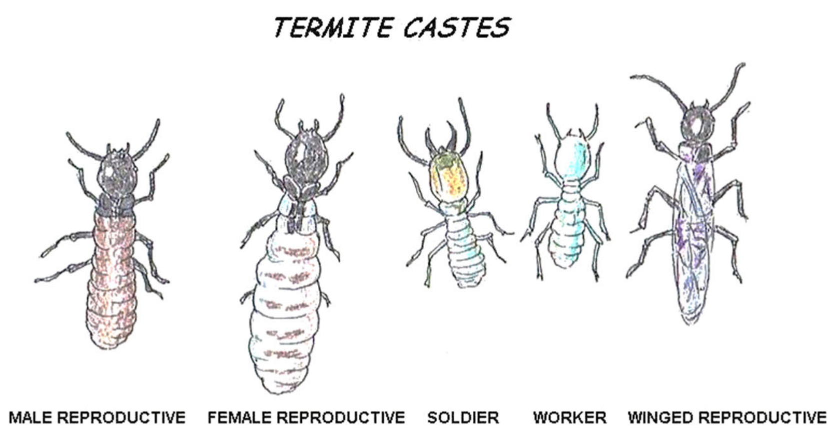
We cannot stress the dangers of pesticide application and the high death and injury rate due to applicators not following label instructions.

Be aware of the how soon you can return to the treated residence
The time required before the residence can be re-occupied will vary by product and will be indicated on product labels. Make sure to inform the business or homeowner when it is safe to reenter the building.

Winged Termites
Large numbers of winged termites swarming from wood or the soil often are the first obvious sign of a nearby termite colony. Swarming occurs in mature colonies that typically contain at least several thousand termites. A "*swarm*" is a group of adult male and female reproductives that leave their colony in an attempt to pair and initiate new colonies.

Alate emergence is stimulated when temperature and moisture conditions are favorable, usually on warm days following rainfall. Swarming typically occurs during daytime in the spring (March, April, and May), but swarms can occur indoors during other months.

However, swarming occurs during a brief period (typically less than an hour and on the species), and alates quickly shed their wings. Winged termites are attracted to light, and their shed wings in windowsills, cobwebs, or on other surfaces often may be the only evidence that a swarm occurred indoors. The presence of winged termites or their shed wings inside a home should be a warning of a termite infestation.

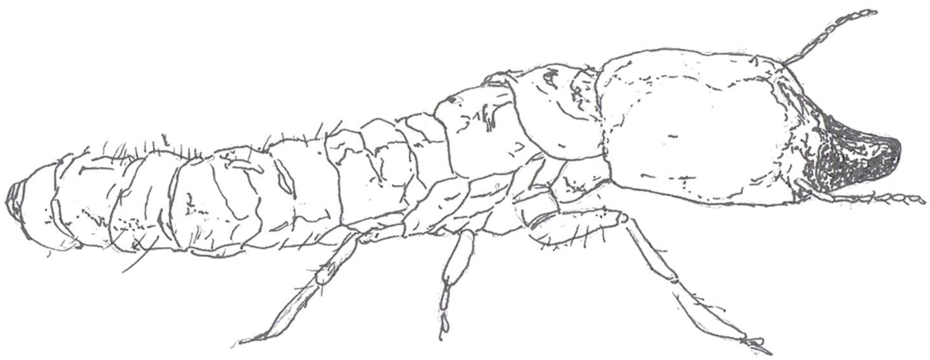


Termite Swarmers

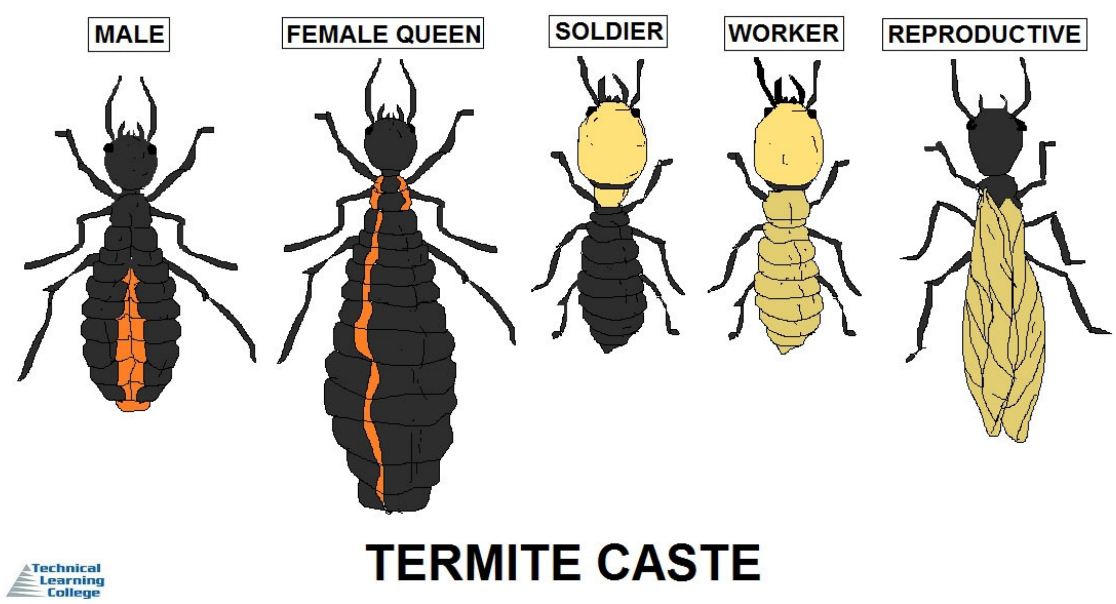
Termite swarmers have straight, bead-like antennae; a thick waist; and two pair of long, equal-length wings that break off easily. Winged termites can be differentiated from winged ants, which have elbowed antennae, a constricted waist, and two pair of unequal-length wings (forewings are larger than hind wings) that are not easily detached. Ants also generally are harder-bodied than termites.

Mud Tubes

Other signs of termite presence include mud tubes and mud protruding from cracks between boards and beams. Most termites transport soil and water above ground to construct earthen runways (shelter tubes) that allow them to tunnel across exposed areas to reach wood. Shelter tubes protect them from the drying effects of air and from natural enemies, such as ants. These tubes usually are about 1/4 to 1 inch wide, and termites use them as passageways between the soil and wood. To determine if an infestation is active, shelter tubes should be broken or scraped away and then monitored to determine whether the termites repair them or construct new ones. Houses should be inspected annually for mud tubes.



DRYWOOD TERMITE (SOLDIER)



Probing interior wood trim reveals termite damage. Subterranean termites do not reduce wood to a powdery mass, and they do not create wood particles or pellets, as do many other wood-boring insects. Depending upon your State or climate, up to half of your work may be termite management. Termite control is an excellent profit making portion of normal pest control activities, however, it is very labor intensive at times.

This course contains EPA's federal rule requirements. Please be aware that each state implements pesticide regulations that may be more stringent than EPA's regulations and these frequently are changed. Check with your state environmental/pesticide agency for more information.

Differences between the 2 Primary Termite Species

	DRYWOOD TERMITES	SUB TERMITES
FOOD	CELLULOSE (derived from wood and wood based products.)	CELLULOSE (derived from wood and wood based products.)
MOISTURE	No outside moisture needed. Can survive on a small amount of moisture within wood.	Require an outside moisture source. This may be from the soil, leaky plumbing, roof tops, etc...
ENVIRONMENT	Colonies live within the wood and do not require contact with the soil.	Normally live and forage in the soil. Can establish a nest above the soil if an acceptable moisture source is found. Build protective mud tubes that lead from the soil to the home. Can move colony within soil when environmental conditions require.
COLONY SIZE	SMALL (few hundred to a thousand termite members.)	LARGE (A well-established colony may contain over 7 million termites. Some species have numerous smaller colonies of several thousand termite members.)
EVIDENCE OF ACTIVITY	"Sand-Like" pellets or "droppings". Kick-out holes on the walls, ceilings or wood. Infestation may take two years before evidence of droppings is present.	1) Mud Tubes ascending from the ground to the structure or protruding from walls and/or trim. 2) Heavy termite swarming within the structure 3) Slits in the wood (flight slits) 4) Uncharacteristic waviness in the wood.
PREVENTIVE MEASURES	1) Use treated lumber during construction. 2) Coat any untreated wood or exposed wood end cuts with an appropriate termiticide. 3) Seal all cracks and crevices with caulking.	1) Install a termite monitoring or detection system at the home or structure. 2) Perform treatment to the soil before construction with an appropriate termiticide. 3) Eliminate conditions conducive to infestation.

CONTROL MEASURES	Light Activity: 1) locate kick-out holes 2) lightly puncture kick-out hole 3) inject appropriate insecticide in kick-out hole. 4) Seal kick-out hole with caulk. Heavy Activity: Tent fumigation	**Prevention through education, detection and elimination of conducive conditions are the most effective and cost efficient control measures. When activity is already present, treat the structure with a liquid termiticide.
DAMAGE LEVEL	Minimal* * When compared to subterranean (ground) termites. Takes up to two years for evidence of activity to be present.	Some species of subterranean termites can consume 15 pounds of wood per week.

Comparison of Dampwood Termites

Pacific Dampwood Termite

The Pacific dampwood termite colony consists of three castes: reproductives, soldiers and nymphs. Winged reproductive, or alates, are almost one-inch long and their color ranges from yellowish-brown to cinnamon-brown. Soldiers display flattened heads with brown or yellowish-brown coloration, while their jaws are black or dark brown. Nymphs are cream colored. Pacific dampwood termites are also known as “rottenwood termites” due to their preference for very moist wood.

Desert Dampwood Termite

The swarmers, or winged reproductives, kings and queens of this species are dark brown; soldiers are brown or yellowish in color; and nymphs have spotted abdomens. Probably the best way to determine the presence of these termites, as well as other species of dampwood termites, is the appearance of the infested wood. Tunnels that have very smooth walls – looking almost like they have been smoothed out by a woodworker using sandpaper, connect chambers within the infested wood.

Nevada Dampwood Termite

Nevada dampwood termites have three primary castes: nymphs, reproductives and soldiers. The reproductive, also known as alates, are often up to ¾-inches long and have dark-brown wings and dark-brown bodies. Nymphs are cream colored and soldiers have brownish-colored heads with very large mouthparts that are used to help defend the colony from predators.

Termite Identification Section

Subterranean Termites

Western Subterranean Termite *Reticulitermes hesperus*

The western subterranean termite, *Reticulitermes hesperus,* is native to most forest areas where it performs the important task of breaking down the large quantities of dead and fallen trees and other sources of cellulose that continuously accumulate in the forests.

The Western subterranean termite is one of the most destructive termites in North America. It is a serious economic timber pest causing millions of dollars of damage throughout the areas where it is located. It is estimated that more than 1 in 5 homes in the high risk activity areas, been or will be attacked at some time by these voracious little insect. Unfortunately, they also attack wooden structures and, if left uncontrolled, will cause weakening and collapse of the structures due to their feeding activity. Other wood products can also be attacked under the right conditions. The presence of termites in buildings is cause for concern not only from the standpoint of safety but also in terms of the cost of preventing further structural damage and replacing damaged wood.

The Western subterranean termite is the most common and most widely distributed termite in the western half of North America. It is a problem for homeowners from British Columbia in Canada, south to western Mexico and east as far as Idaho and Nevada.

Western subterranean termites are in plague proportions in central and southern parts of California, particularly in the older urban areas of the San Francisco Bay Area, Sacramento, Reno, Fresno, Los Angeles, Orange County, San Fernando Valley and San Diego.

This native American pest can enter structures through cracks less than 1/16 of an inch wide, even the minute openings found in concrete slabs, around drain pipes, and between the slab and the foundation.

Western subterranean termite colonies are usually located in the ground below the frost line, but above the water table and rock formations. They are typically detected by the presence of the mud tubes they construct, or when large numbers of winged termites "swarm" or leave the colony to search out mates. Swarms occur in the daytime, and in California, they occur on warm, sunny days during the fall, winter or early spring. In the northern sections of the termites' range, spring swarms commonly occur in the absence of rainfall.

Western subterranean termites are highly destructive to Douglas fir and other common building timbers. Western subterranean termites rapidly eat out the internal sections of structural timbers - devouring mainly the spring wood, and preferring to leave the harder summer wood sections.

Western subterranean termite workers look like white or cream-colored ants. Soldiers have an orange, rectangular-shaped head with large pincher- like mouthparts that are used to fight off colony invaders.
Swarmers are about 3/8-inches long (wings included), and their body is dark brown. They have two pairs of wings, and the front wings are larger than the hind wings.

Thin Honeycomb Shell
Western subterranean termite infested timbers are often left as a thin shell with a honey-comb of layered hollow sections (as illustrated on left) packed with a composite of partly digested timber and soil extract. If this soil timber composite is moist, chances are you'll also find live termites close by. Western subterranean termites prefer a moist dark damp environment - it is essential for their survival.

Social Interdependence
Within a termite colony there are members of different castes, each with a different role to perform and all interdependent upon each other for the survival of the termite colony. The different castes include the queen, king, the winged reproductive (young kings and queens), soldier and worker termites.

Biology and Description
The western subterranean termite is a social insect, living in colonies that have just a few thousand to sometimes millions of individuals. Each colony will include reproductives, workers and soldiers. Winged reproductives emerge in a mass nuptial flight in April and May. These flights are often the first indication homeowners have of termite infestations. A small emergence may occur in late summer.

Reproductives are about 5-6 mm long and are often confused with winged or '*flying*' ants because of their black bodies and transparent wings. The following figures illustrate how to distinguish between the two types of social insects. The waist of ants is narrow whereas termites have a broad waist between the thorax and abdomen. The antennae of ants are elbowed whereas those of termites are straight with bare bead-like segments.

Ants have two pair of transparent wings with few veins and are not of equal length, and often have a dark patch along the outer margin of the front wing, whereas the wings of termites are about equal in length (8-9 mm) and have many fine veins.

Courtship Run
After flight, males and females will break off their wings, form tandem pairs that have a courtship run on the ground, and then together seek a suitable site to begin a colony--in wood buried in the ground or laying on the surface of damp ground. The initial rate of colony growth is slow, however additional egg-laying females are produced which increase the rate of colony development.

Large colonies will subdivide if food sources are abundant. Winged adults do not appear until the colony is 3 or 4 years old, then mass emergences will occur each year.

Worker Termites
Worker termites are ¼ inch (6 mm) long and pale cream in color (worker ants are yellow, red, brown or black); soldier termites are the same size and color; however, their heads are enlarged (almost half their body length) with noticeable black jaws.

Soldiers will tap their heads against the wood when disturbed which is another means of detecting the presence of termites.

Workers construct the distinctive shelter tubes and collect food to feed the young and other members of the colony. Soldier termites are responsible for guarding the colony and its occupants. Termites continually groom each other to obtain certain secretions. These secretions help regulate the number of individuals in the various castes.

Identification Tips Western Subterranean Termite - Soldier Caste
The Western Subterranean soldier termites have an orange colored rectangular armored head with mandibulate pinchers which they use to crush member of the ant family - their arch enemy in the insect world. The Western subterranean termite soldier has a fontanelle (frontal gland pore or hole) on their forehead used to squirt a white sticky latex, mainly as a defense mechanism against ants.

The soldier termite is usually the first to be seen in large numbers when any active termite workings (mud shelter tubes or damaged timber) are opened. Soldier termites will rush out to guard the opening whilst worker termites repair the breach.

Termite Alate Swarmers (or reproductives) are commonly seen when they swarm during daylight; they have eyes; are poor fliers but are swept along by the wind; they land, drop their wings, find a mate to become king and queen of a new termite colony.

Western Subterranean Termite Identification Tips - Alate Caste
The western subterranean termite swarmers are about 3/8" long (including wings) with a dark brown body and a small fontanelle (frontal gland pore) on its head. Their wings are brownish grey with two dark solid veins along the forefront of the front wings. The front wing is distinctly larger than hind wing.

Swarming
In the northern part of their range, swarming takes place in the spring, but without rain. In the southern areas, swarming usually follows rain. The swarmers are emitted in their thousands when a mature termite nest is large and well established.

Western subterranean termites swarm in large numbers over a wide area to find a mate from another colony nest to start up a new colony. A suitable location for nesting should provide moisture and a readily available timber food source close by.

During the warmer months you may see the flying alates (winged reproductives) caste take to the air and swarm in their thousands, in order to meet up with swarmers of other nests in the area so they can establish new termite colonies in the local area. This is a sure DANGER sign that a large mature termite nest is close-by. Such a nest may contain hundreds of thousands of Western subterranean termites within range of infesting the timbers in your home.

Colony Information
Colony nest development is slow in the first few months, with the egg-laying capacity of the new queen termite peaking after a few years. The swarmers are emitted in their thousands when a mature termite nest is large and well established. Swarmers are usually produced after this period and are an indication a large termite nest is in the vicinity, a sure danger sign and a warning that professional treatment is required.

The colony nests of Western subterranean termites are usually located in the ground below the frost line, but above the water table. Mud galleries or "shelter tubes" are constructed across hard objects in order to gain access to timber food sources. Western subterranean termites constantly search for new food sources. They are known to enter buildings through cracks in concrete flooring or to travel under parquetry or tile flooring through gaps of less than 1/16" wide.

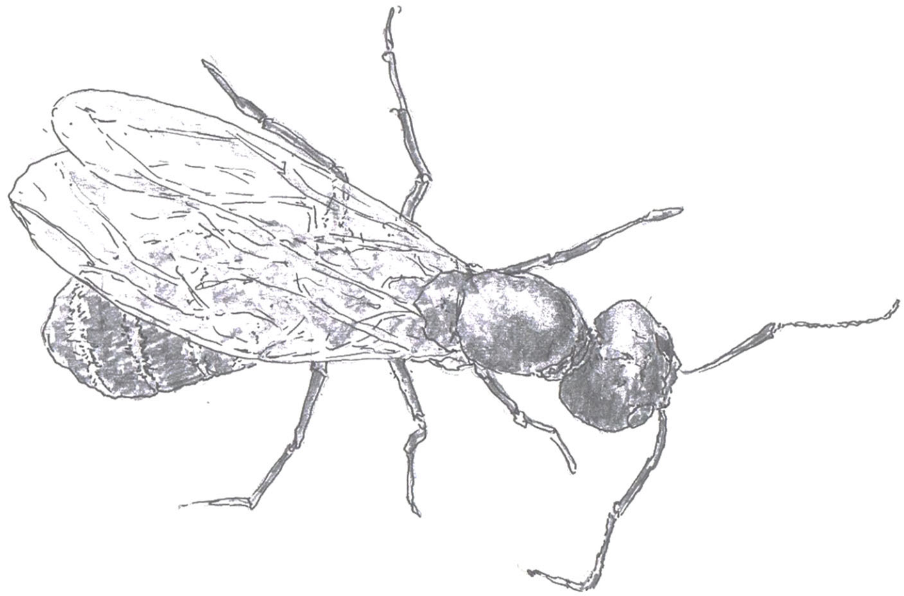
Where moisture regularly collects inside the wall or other cavities of a building, possibly from faulty plumbing or broken roof tiles, the Western subterranean termite can develop a subsidiary colony nest that may not require contact with the ground to ensure its survival. They build a central colony nest from which they construct underground tunnels that radiate within a 100-yard radius from a central colony nest in search of a timber (cellulose) food source.

Western subterranean termites travel in these mud shelter tubes as protection from predators, sunburn, and dehydration and to maintain a high humidity environment that is essential for their survival.

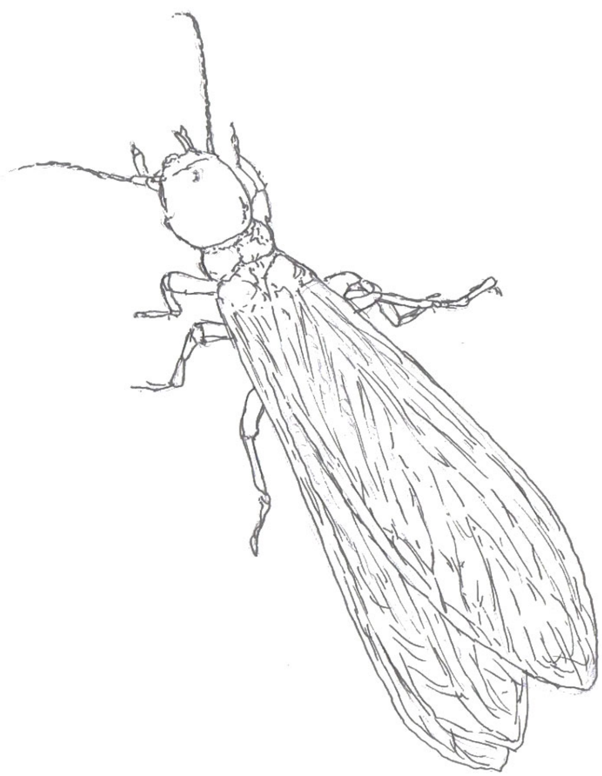
Western subterranean termites are highly secretive, preferring to enter a building through areas inaccessible to inspection, such as, through in-fill patios, fire heaths, expansion joints and cracks in concrete slab (on-ground) flooring.

Western subterranean termites can pass through a 1/8" crack or an expansion joint (eating through the rubber compound) between adjoining concrete on ground flooring. Western subterranean termites can also travel under timber parquetry and other floor tiles to get to the wall framing timbers in a building.

Western subterranean termites have acute survival instincts. If they are shaken up or disturbed, the termites often will abandon the associated area and move on to secretly cause damage in other areas in the building.



WINGED ANT



WINGED DAMPWOOD TERMITE

Desert Subterranean Termites

Have you been to the desert and seen a piece of wood that looks normal until you pick it up and the board is nothing but a hollowed out shell? Desert subterranean termites are commonly distributed throughout the lower deserts of northwestern Mexico, southern California and southern Arizona.

Here are a few important facts you should understand about the life and behavior of desert subterranean termites, compared to the more common Eastern or subterranean termites such as Formosan or Eastern subterranean:

- Desert subterranean termites are able to survive in drier conditions than Formosan or Eastern subterranean termites.
- Soldiers of desert subterranean termites are characterized by their slender and straight mandibles, in contrast to the relatively thick, curved mandibles of Formosan or Eastern subterranean termites.
- Their small size and ability to forage under dry conditions allows them to occupy a niche not exploited by other subterranean termite species.
- Preliminary research suggests that baiting for desert subterranean termites requires more time than for others. Given the small size of desert subterranean termite soldiers and workers, they are apt to penetrate smaller cracks in concrete and masonry that are too narrow for foragers of other subterranean termites to enter.
- Subtle differences in foraging behavior do exist. Foraging tubes are lighter in color, narrower, and more circular. Sometimes, desert subterranean termites will openly build very narrow, free-hanging tubes from ceilings, shelves and overhangs. Don't be surprised to see tubes as long as 6 to 12 inches in length. These tubes are often re-used by desert subterranean termites.

Identification of Swarmers and Soldiers
The Desert subterranean termite swarmers are about 3/8" long including their wings. Their body is a pale yellowish brown and a fontanelle (front gland pore) is indistinct or absent. The wings have two prominent hardened veins in the front portion.

The wing membrane is translucent, almost colorless, with a few barely visible hairs. The front wing is larger than the hind wing.

The head of the Desert subterranean termite soldier is rectangular in shape, the length about twice the width. It also has a fontanelle (front gland pore) on the forehead. The body (pronotum) is flat and almost as wide as the head.

The Desert subterranean termite soldiers have long powerful pointed jaws (mandibles) that are slender, fairly straight but slightly curved inward at the tip. This contrasts with the mandibles of the Western subterranean termite that are thick and curved.

The small size of Desert subterranean termites and their ability to forage under dry conditions allows them to occupy a niche not exploited by other subterranean termite species.

Identification of Timber Damage
Desert subterranean termites prefer to eat the springwood in timbers, generally avoiding the lignin in summerwood. Damaged timber appears honeycombed, with soil in the galleries. The Desert subterranean termite is less dependent on moisture and decay than other subterranean termites. It will readily attack dry, sound wood. A typical sign of infestation is the presence of “drop tubes” coming from the ceiling rafters and sheetrock/plasterboard and/or holes in the sheetrock plugged with feces.

Identification of Mud-Shelter Tubes
Desert subterranean termites prefer to forage in shaded soil or areas made wet by irrigation. They will readily construct mud shelter tubes up, over or around solid objects in order to reach a timber food source. These mud-tubes are slender, solidly built and pale yellow to tan in color. Desert subterranean termites mud-tubes are more circular in cross section than those of the Western subterranean termite whose mud-tubes are flattened in cross section and dirty light brown in color.

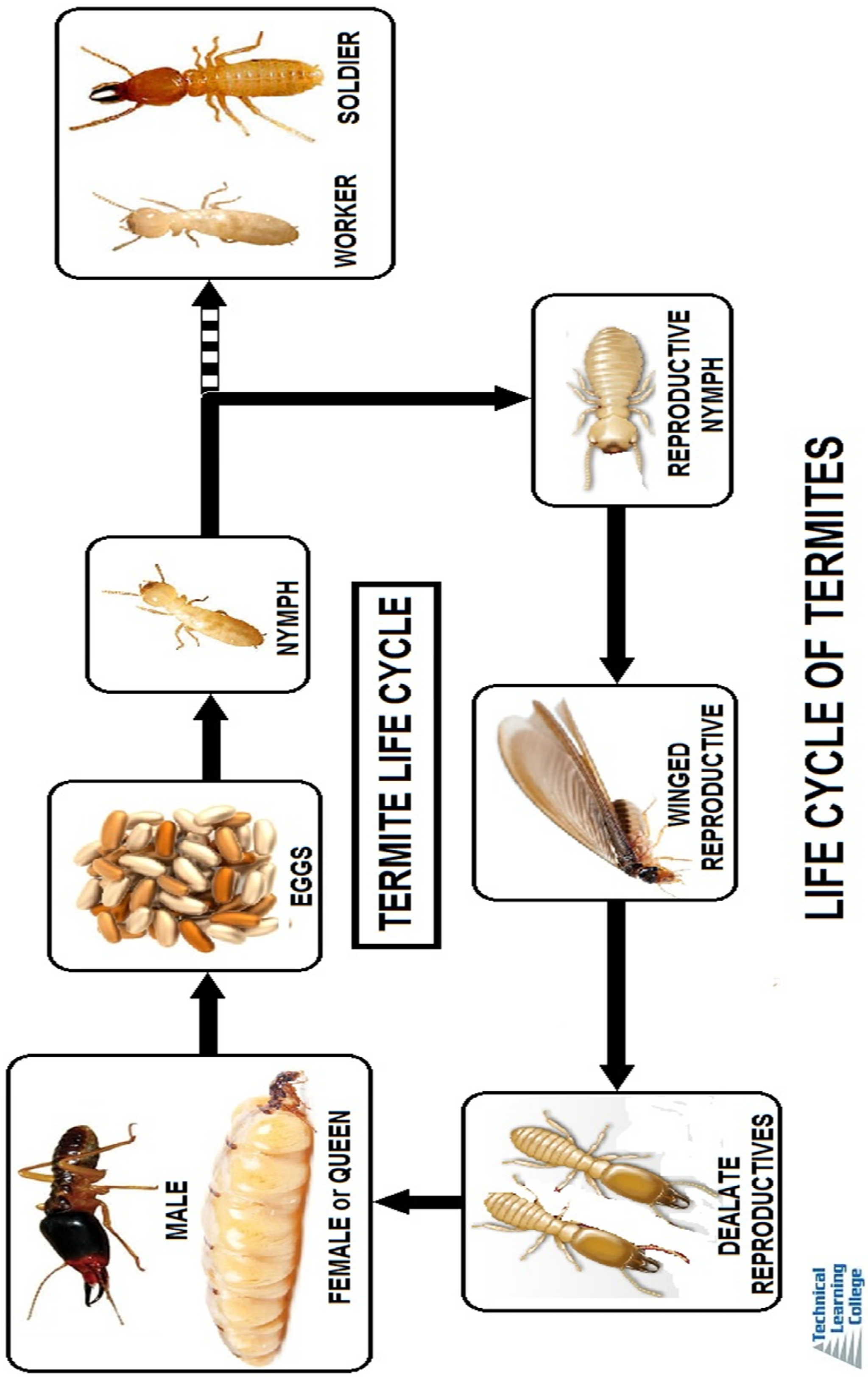
Biology and Habits
Desert subterranean termites most often swarm at night during the rainy season, from July to September, usually after rainfalls. The moist soil provides the nuptial Desert subterranean termite swarmers with the best chance of surviving and developing a new colony. The male and female pair off and enter the soil where they excavate a cavity or cell.

A well-developed mature colony of Desert subterranean termites may contain more than 300,000 termites, including a large number of secondary reproductives (queens) that can readily break off from the primary colony to form separate colonies. Desert subterranean termites commonly have a foraging territory of up to almost an acre.

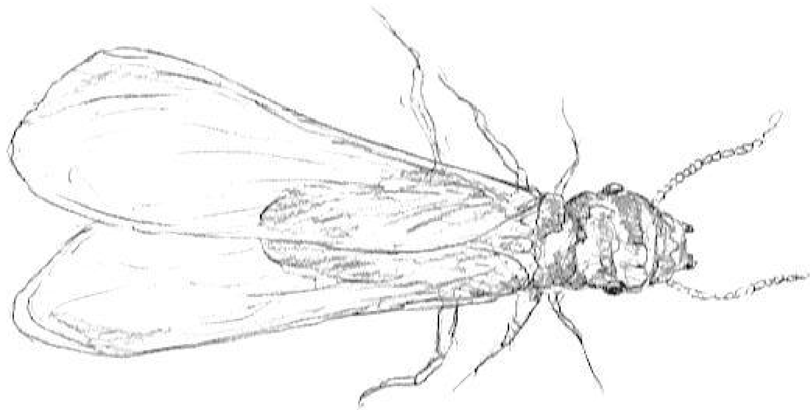
Desert subterranean termites require only a tiny gap, about 1/32", in concrete flooring or mortar joints in brick walls to gain access to the wall, roofing and other structural timbers in a building. The Desert subterranean termite can penetrate cracks in concrete and masonry that are too narrow for foragers of other subterranean termite species to enter. Desert subterranean termites often build their mud-shelter tubes as freestanding tubes that "drop down" from rafters, ceilings and subfloor areas under buildings.

Some quick facts about Western Subterranean Termites

- Although Western subterranean termite colonies are largely located in the ground, secondary colonies can exist above ground if there is a constant source of moisture.
- Western subterranean termites will often build mud tubes for travel between their colonies and their food sources.
- Damage caused by Western subterranean termites is most commonly found in the basement and at ground level, although the termites will attack wood at higher levels.
- Development from eggs to adults may take more than 5 months, and workers may live from 3-5 years.
- Swarmers are usually produced from mature colonies that have been active for a number of years.
- Research has shown that populations are higher in urban areas than in undeveloped habitats. The termites prefer soil temperatures between 84° and 90° F — never above 104° F.


LIFE CYCLE OF TERMITES
TERMITE LIFE CYCLE
MALE
FEMALE or QUEEN
EGGS
NYMPH
WORKER
SOLDIER
REPRODUCTIVE NYMPH
WINGED REPRODUCTIVE
DEALATE REPRODUCTIVES
Technical Learning College

Drywood Termite (Kalotermitidae)



DRYWOOD TERMITE SWARMER

Approximately 400 global species of drywood termite species are known, but only a few species are important in the United States. Drywood termites live in dry sound wood (usually less than 12% moisture), and derive their moisture requirements from the wood they consume. Infestations can occur in structural timbers in buildings, pieces of furniture, flooring, doors and doorframes, window trim, wooden picture frames, and other isolated pieces of wood. Drywood colonies are relatively small, with a few thousand members lacking the true worker caste, and there are often multiple colonies in the same structure.

Drywood termites do not need a connection to soil and there is no soil in their feeding galleries. They do not build mud tunnels; they construct large, irregular galleries that run across and with the wood grain, with a very smooth, clean, and sandpaper-like appearance. The galleries are connected by openings small enough for one termite to pass through. The sure sign of drywood termite feeding is their fecal pellets that are ejected from the galleries via kick-out holes, often found right below the damaged wood. These pellets are quite unique and are hard, elongated-ovals with rounded ends, and have six concave sides.

Powderpost Termites

Powderpost or "furniture termites" (Cryptotermes spp.) have small fecal pellets and are smaller in size than other drywood termites. Their feeding on furniture or movable wooden objects can reduce wood to a fine powder. They can be found in Florida, southern Louisiana, Texas, Puerto Rico, and Hawaii. Some have been found as far west as Los Angeles and as far north as Ontario, Canada. These creatures are also found in antique furniture.

Drywood termites are hidden insects that are difficult to detect. They live deep inside wood; and except during periods when they swarm or when repair work is being done on infested homes, they are seldom seen.

Colonies are small (usually fewer than 1,000 individuals), can be widely dispersed, and take years to mature. The most common sighting of drywood termites is flying adults (called swarmers) that occur during daytime hours during summer and fall.

Dampwood termites also can swarm during summer and fall, but they can be differentiated from the western drywood termite based on their larger size and attraction to lights at dark. In parts of southeastern California another species of drywood termite, Marginitermes hubbardi, and species of desert subterranean termites may also swarm to lights.

While a homeowner may initially detect the presence of drywood termites when they swarm or if fecal pellets are discovered, inspecting and determining the extent of an infestation requires experience and is best done by a professional.

By state law, the minimum requirement for termite inspections includes visual searches of accessible areas. However, detection of difficult-to-find infestations may require removing walls, paneling, and stucco, as well as using ladders and scaffolds.

During a structural inspection for drywood termites, inspectors look for feeding damage, shed wings, fecal pellets, and kick-out holes, i.e. small holes (less than 2mm in diameter) through which termites push fecal pellets out of the wood. Again. These unique fecal pellets have six hexagonal sides and are diagnostic for drywood termites. It is not possible to determine, from fecal pellets alone, whether the infestation is currently active or how extensively the infestation extends throughout the wooden piece or structure.

Dampwood termites also produce fecal pellets that are rounded at both ends (football shaped) and elongated, but they lack the clear longitudinal ridges common to drywood termite pellets. Other structural pests that can be confused through differential diagnosis include wood boring beetles and carpenter ants, see the Wood Boring Beetles of the Home and Carpenter Ants pest section of this course. The final confirmation of drywood termite pellet identification from other wood destroying pests or wood debris may require help from an expert. Cleaning up the fecal pellets around a kick-out hole and checking a few days later to see if new pellets have appeared can help to determine if an infestation is active (as building vibrations and movement may also cause some pellets to appear).

Other detection methods that have been commercialized and tried by the pest control industry include dogs, feeding-sensitive (acoustic emission) devices, fiber-optical devices, movement-sensitive (microwave-based) devices, and odor detectors; but these methods are infrequently used. Visual inspection by inspectors for evidence of termites and damage remain the mainstay of the industry.

Drywood Termite Management
Because of the difficulty in detecting drywood termites and determining the extent of the damage, do-it-yourself treatments are not recommended. In addition, the chemical products needed for controlling these pests are not generally available for homeowner use. Except for wood removal, homeowners should seek help for infestations of drywood termites from pest control professionals.

Existing Infestations
All drywood termite control methods can be categorized as either whole structure or localized. More information, see the section in the rear of course that summarizes the advanced control methods and elimination.

A whole-structure treatment is defined as the simultaneous treatment of all infestations, accessible and inaccessible, in a structure.

Localized or spot treatment is more restrictive and is often applied to a single board or small group of boards. Homeowners should be advised to understand the distinction between whole-structure and localized treatments when deciding which method to select, because all treatment methods are not equal.

Whole-structure treatments have an advantage over localized treatments in that they should eliminate all infestations, even hidden ones. With the uncertainty of current detection methods, particularly when drywall or other wall coverings conceal infestations, there is always some doubt as to the extent of drywood termite colony boundaries and the number of colonies within homes. Consequently, one can never be sure all infestations have been treated when applying localized treatments. The strengths and limitations of whole-structure vs. localized treatments are outlined in the rear section of this course under advanced termite control.

Detecting Drywood Termites

These highly designed creatures nest above ground, away from soil. Since colonies are usually constructed inside wood, finding these termites can be difficult during routine pest and dry-rot inspections. Therefore, one of the best ways to identify an active infestation is the presence of fecal pellets. These pellets are cream to reddish-brown or black. The color of the pellets is not related to the color of the wood. The pellets are about 1-2 mm long and distinctively six-sided, making them easily distinguishable from other wood destroying organisms. Pellets usually fall into piles as the termites push them out of the infested wood.

Fecal Pellet Differences

Drywood termite fecal pellets are kicked out of the colony by workers and may accumulate below infestations. Fecal pellets have a distinct ridged shape and are about 1/25" long (about the size of table salt). Subterranean termites do not kick out dry fecal pellets from their colonies and drywood termite fecal pellets are much larger than the boring dust particles of Powderpost beetles.

Infestation Signs

Signs of infestations by drywood termites and control measures differ drastically from those for subterranean termites.

- Discarded wings accumulating around window sills or in spider webs
- Signs of infestation include:
- Winged insects emerging in evenings and night attracted to lights or TV.
- Wooden pellets (much smaller that rice grains) accumulating on floors or under furniture.
- A sign of advanced infestation is surface blisters. These termites sometimes tunnel close to the surface giving the wood a blistered appearance. Infestations may be detected by tapping the wood every few inches with the handle of a screwdriver. Damaged wood sounds hollow - a papery rustling sound indicates tunnels just beneath the surface.
- Baiting systems (such as Sentricon, First Line, Exterra) will not protect a structure from drywood termites
- Coastal and southern areas of the state are more likely to have an infestation of drywood termites occur.
- Colonies are smaller and develop over a longer period of time than do subterranean termites therefore the potential for structural damage over a given period of time is less.
- Control methods include whole structure fumigation, spot treatment with insecticides, or spot heat, shock, microwave, and liquid nitrogen treatment. Heat treatments have been used as whole structure treatments.

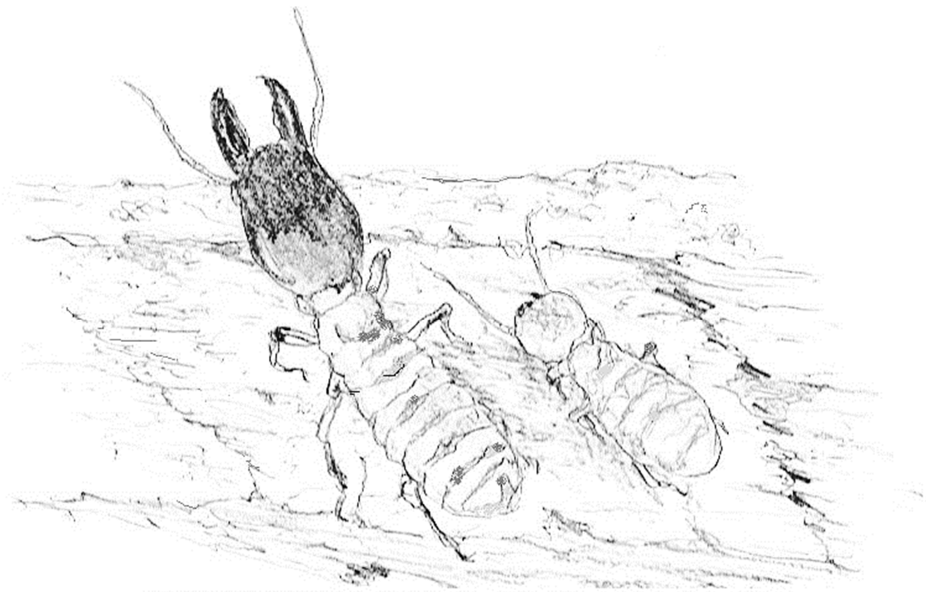
• Direct treatment of lumber MAY provide protection if the drywood termites must tunnel through the treatment to infest the wood.
• Drywood termites occur in small colonies in isolated wood pieces. Multiple colonies can infest a structure simultaneously
• Drywood termites remain hidden within the wood or other material on which they feed, so they seldom seen. Fecal pellets are ejected periodically, while swarmers fly from colonized wood in late spring and summer.
• Drywood termites will also infest pieces of furniture (particularly antique pieces). Removal of the item and separate treatment of the piece may be all that is necessary in some instances.
• Even though colonies are slow to develop if left unchecked for extended periods of time substantial damage can occur.
• Galleries or tunnels in the wood made by drywood termites cut across the grain of the wood and destroy both soft spring wood and the harder summer growth. Galleries made by the subterranean species follow the grain of the wood and the soft spring wood is attacked first.
• In some cases, treatment of an infestation of drywood termites may not be needed if the area of infestation can be identified and physically removed (this may or may not be practical from a structural standpoint).
• Late Spring and Summer months are the peak season for winged drywood termite swarming flights.
• Swarming (mating flights) often occur in the evening hours.
• Termite protection contracts are usually for ONE type termite only. A SEPARATE contract is usually required for treatment and protection from subterranean termites and drywood termites.
• Treatment of the soil under and around the structure will not protect a structure from drywood termites
• Winged termites can be distinguished from winged ants because termites have a thick waist, straight antennae, and equal-length wings whereas ants have a distinctly thin or wasp-like waist, elbowed antennae, and shorter hind wings than fore wings.

Summary
Drywood termites are important structural pests in tropical and warm/dry climates.

Unlike most other termites, drywood termites do not need contact with soil moisture.

Control of "drywoods" can be more difficult because their colonies are not confined to the soil.

Pacific Dampwood Termite *Zootermopsis angusticollis*



DAMPWOOD SOLDIER TERMITE (L), NEXT TO A WORKER TERMITE

The Pacific dampwood termite is the largest and the most significant dampwood termite in the United States. This species ranges from Baja California and Mexico to British Columbia. They have been found up to 6,000 feet above sea level, but more commonly in the cool and humid coastal areas. These termites get their name from the need for a high moisture content in the wood. They are extremely common in wooded or forest environments in cooler climates. Colonies are generally small by termite standards, with several thousand workers in a mature colony. There is no true worker caste, as nymphs perform the duties of the colony and all nymphs become either adult soldiers or adult alates. Alates swarm after sundown on warm summer evenings. The reproductives may attack wood without soil contact. Damage is indicated by large galleries that usually follow the direction of the grain, and with fecal pellets packed into some of these galleries. The texture of the sides of the galleries is “velvety”, or slightly rough textured.

Identification of Swarmers and Soldiers
Swarming may occur throughout the year, but most often from August through October. Swarming usually will occur on warm humid evenings just before sunset. The reproductives are strongly attracted to light. Swarmers are up to 1" in length and are light to medium brown with dark brown wings.

The Pacific dampwood termite colony consists of three castes: reproductives, soldiers and nymphs. Winged reproductive, or alates, are almost one-inch long and their color ranges from yellowish-brown to cinnamon-brown. Soldiers display flattened heads with brown or yellowish-brown coloration, while their jaws are black or dark brown. Nymphs are cream colored. Pacific dampwood termites are also known as “rottenwood termites” due to their preference for very moist wood. (Other species of dampwood termites are also called “rottenwood termites) Soldiers have a large head armed with long black toothed mandibles. The anterior portion is black generally shading to a dark reddish-brown in the posterior position.

The abdomen and thorax are a light caramel color, the abdomen varying according to the stomach contents at the time. The largest termites in the United States, soldiers may be very large, reaching 5/8 to 3/4".

Identification of Timber Damage
The tunnels vary greatly in size and shape and in sound timber may favor the softer springwood. Fecal pellets are found throughout the tunnels, and are hard small, oval and about 1/25“ long. The color of the pellets may vary according to the type of wood being consumed.

Pacific Dampwood Termite Biology and Habits
This species will attack wood of all types throughout its range. Timbers in contact with the soil or structures built near or over water are common targets. This species is known to be very tolerant of moist conditions, even being found in pilings subject to tidal flooding. Colony size varies but may contain as many as 4,000 individuals.

Colony growth is aided by the production of secondary reproductives. Like other termites this species aid in the spreading of wood decay fungi, the spores of which are carried in the gut and on their bodies.

A well-established colony will produce winged reproductives which may infest nearby timber.

Summary
The life history of the Pacific dampwood can be summarized as follows. Both male and female swarmers excavate a chamber, they enter, and the chamber is sealed. They mate and within about 2 weeks, eggs are laid and the colony is founded. The queen lays about 12 eggs. The second batch is laid the next spring.

Swarms tend to occur on warm, humid evenings during the late summer or early fall, often appearing after early rains. These swarms are smaller than those of other termite species, as Pacific dampwood termite colonies only foster up to about 4,000 members.

After mating, male and female alate pairs usually begin the new colony in sound wood such as recently cut logs and the living parts of otherwise dead trees.

Desert Dampwood Termite *Paraneotermes simplicicornis*

Desert Dampwood Termites are found in Arizona, New Mexico, Texas, and Southern California. Living where the habitat is dry and arid in these regions of the United States. They ingest damp wood that is buried in the ground. Munching termites attack tree roots, bushes, door frames and fence posts. The Dampwood also feeds on live trees – wood that is under ground level.

Dampwood termites are almost an inch long, which is quite a bit larger than the Subterranean or the Drywood variety. Swarming occurs between January and October – which is a long swarming season. These insects only infest wood and timber that contains high water content. The 'Dampwoods' come in a variety, and each is named for the location in which they are found: Desert Dampwood Termites, Florida Dampwood Termites, Nevada Dampwood Termites, and Pacific Dampwood termites.

Identification of Swarmers and Soldiers

The swarmers of this species are dark brown, swarming during the daytime. This species prefers the arid and semi-arid regions of the southwest, from Texas through California and Mexico. A prevalent pest for gardeners, these termites are known for destroying vegetation, notably citrus. These pests also prefer to attack timber and other wood high in moisture. Desert Dampwood termites are also notorious for emitting a strong odor, and unlike other termites does not create mud tubes. They can be found residing in dampened wooden areas, and are not likely to burrow in soil.

Identification of Timber Damage
This species infests wood at or below ground level in the southwestern United States. It sometimes girdles young citrus trees and grapevines below the soil line in desert areas. In the southwest it attacks living trees and bushes and is a problem for citrus groves. It is a pest of timbers in service, infesting moist timbers that are in contact with soil. Untreated posts, poles, and fences are attacked below ground level.

Desert Dampwood Termite Biology and Habits
This species does not build mud shelter tubes above the ground in order to reach wood. This is an unusual dampwood termite in several respects. The colonies extend from the wood into the soil, they sometimes kill living shrubs and trees, frass is cone-shaped rather than cylindrical, and the termites have a pungent odor. They also have directed trail-following behavior, unlike other dampwood termites.

The nymphs are the caretakers of the colony and feed the kings, queens and the soldiers. This desert termite prefers to eat damp wood that is below ground, but will also consume shrub or tree roots, fence posts and doorframes. Desert dampwood termites also damage living trees by feeding on and girdling them below the ground surface.

Paraneotermes simplicicornis causes significantly less economic damage than subterranean termites and other dampwood termite species. Desert dampwood termites seldom infest homes, but when they do, they are likely to be found in wet wood that is kept damp by water leaks or excessive moisture from standing water. Therefore, the presence of this termite often indicates moisture and wood decay within the home. For this reason, it is very important to make sure that gutters and downspouts work properly to drain rainwater away from the house.

This desert species **rarely damage homes** like others of their kind. The desert dampwood termite is **not classified as a major** structural pest in the United States.

When found in a home they are usually found in wet wood or wood that is kept wet by constantly dripping water. Occasional infestations of dwellings are commonly found in door frames or baseboards.

The desert dampwood termite is the only dampwood termite considered a pest of wooden structures in Arizona.

The swarmers, kings, and queens of the Desert Dampwood Termite species are brown. They have brown bodies and brown wings. Soldiers are yellowish brown, and nymphs are a creamy color with a spot on their abdomen. This spot indicates the presence of food.

Description

- Soldiers are up to 5/16" long with flat heads and short wide black mandibles. Desert Dampwood Termite soldiers also have an antenna on either side of their head.
- Nymphs take care of the colony and feed the others. This muncher's favorite food is damp wood even though they like dryer weather climates. If trees around your home show signs of infestation, you may need to take them down. Weak wood trees are a hazard to the home.
- The winged adults swarm starting in May until September – in the daytime. Termites swarm, mate and start a new colony. The desert dampwood prefers citrus trees and can use the sap for required moisture.
- This termite has a strong odor.
- This species does not build mud tubes to stay hydrated or to reach a wood source. The colony itself will stretch out over a distance to go from wood to soil. This distinction makes the Desert Dampwood Termite different from others of its kind.
- The desert termite lives in small colonies – less than 1500 termites. If infected wood is found – look closely for tunnels inside the wood, the tunnels will appear smooth as is sanded.

Nevada Dampwood Termite *Zootermopsis nevadensis*

Nevada Dampwood Termites are found primarily in Nevada, Idaho, California, Washington, and Oregon. This termite dwells in mountain regions and likes the high altitude and dry climate. This termite is attracted to wooden structures that are in contact with soil and built over or near water.

Even though their preference is a dryer climate, moist conditions are tolerated. This muncher also assists in the spreading of wood decaying fungi by carrying its spores on their bodies and in their stomachs. Soil contact is not necessary but will nest in fallen wood that has been buried.

Nevada Dampwood Termites do not like highly populated areas. But when these critters do infest a home they usually attack wood siding, fence posts, pilings, pond bridges, and downspouts.

Nevada Dampwood Termite swarmers are dark brown with wings, growing up to 3/4″ long. The soldier termites have long flat heads with straight sides. Workers have large abdomens and are light brown. Nymphs are a creamy color with a spot on their stomachs (digesting food).

Occasionally termite control experts will find a home infestation. It usually occurs in the wood siding of a home where the siding touches the ground, around downspouts, and in fence posts. They will not normally attack homes because the moisture content is too low.

Swarming

The Nevada Dampwood Termite swarms in the spring, summer and early fall. When swarming, they seek out wood with a high moisture content to start new colonies. The most obvious sign of infestation is discarded wings and alates found in your home or around your property.

Upon inspection of your home, if you find an infestation you can do certain things that will discourage their occupation.

- Remove wood piles that are around your home
- Replace infested wood with pressure treated timber
- Fix any leaks around your home

Summary

Nevada dampwood termites have three primary castes: nymphs, reproductives and soldiers. The reproductive, also known as alates, are often up to ¾-inches long and have dark-brown wings and dark-brown bodies.

Nymphs are cream colored and soldiers have brownish-colored heads with very large mouthparts that are used to help defend the colony from predators.

Formosan Subterranean Termites

Introduction

The Formosan subterranean termite, Coptotermes formosanus (Shiraki), was first described as a species in 1909 from specimens collected on the Asian island of Formosa. It is now generally accepted that the termite is native to China and Formosa. This termite is considered a serious structural pest whenever it occurs. The Formosan subterranean termite has been found in Japan, Sri Lanka, Philippines, Guam, Hawaii, South Africa and the continental United States. Although officially reported in Hawaii in 1913, newspaper reports indicate that the termite was on the island as early as 1869.

The first report of the Formosan termite in the continental U.S. was from a Houston shipyard in 1965. It was reported in Louisiana in 1966 and Charleston, S.C. in 1967, although specimens collected in Charleston in 1957 indicate that the termite was introduced nearly ten years earlier. The Formosan termite has also been identified in Broward and Dade counties in Florida (1980-3); Mobile, Lee, and Baldwin counties in Alabama (1985-87); Memphis, TN (1985); North Carolina (1990); San Diego, CA (1991); and Atlanta, GA (1993). It is believed that these infestations were transported in infested building or plant materials from areas where the termites were well established.

Biology

As with the native subterranean termites, Formosan termites initiate new colonies by sending out winged reproductives (alates) from established colonies. The Formosan swarms occur from May to July depending on the area that receives constant humidity and warmth. Formosan termite swarms occur from dusk to midnight and the alates are attracted to lights. After a short flight (usually not more than 20-50 yards) the alates lose their wings, pair off, and seek a small crevice in moist wood to begin the new colony.

It takes 3-5 years for a mature colony to develop from a queen, which lays approximately 2,000 eggs/day. Mature colonies can have a population of 10 million foraging workers, soldiers, a primary queen, and several secondary reproductives. The foraging territory of a mature colony can occupy several thousand square feet.

Destructiveness

The Formosan termite is known to attack over 50 species of living plants as well as structural lumber. A survey in New Orleans showed that 10% of the utility poles in the city are infested with the Formosan termite. This termite is often described as aggressive in both its feeding habits and foraging tenacity.

They cannot eat through concrete but have been known to attack non-cellulose materials like plastic, asphalt, and thin sheets of soft metal. Although laboratory studies indicate that the individual Formosan termite eats slightly more wood than the native subterranean termites the larger colony populations found with this termite can cause severe structural damage to unprotected homes in 2 years.

The Formosan subterranean termite usually enters structures from colonies maintaining contact with ground to provide the necessary moisture requirements. However, the Formosan termite, more than the native subterranean species, is able to initiate colonies which have no ground contact (aerial colonies).

Recognition

Damage

The damage caused by the Formosan termite is similar in many respects to the damage done by native subterranean termites. Termite feeding will follow the grain in a piece of structural lumber, but the Formosan termite is more likely to feed on both the summer and spring wood, leaving a larger hollow space in the damaged lumber. Native subterranean termites usually fill their feeding galleries with soil and excrement; whereas the galleries of the Formosan termite are cleaner--practically soil free and covered with whitish spots.

In severe infestations, Formosan termites will fill hollow spaces, or even wall voids, with a combination of termite excrement, macerated wood, saliva and soil. This material, called carton, can be used by the Formosan termite to form nest-like structures and is unique to the Formosan termites. Carton nests are constructed in or near the feeding site and a single colony may have several of these auxiliary nests – each containing secondary reproductives.

Insect Identification

Three caste forms of subterranean termites are often found at the site of an infestation--alates, soldiers and workers. Only the alates and soldiers can be used for identification.

Alates - Below is listed a comparison of Formosan alates and the three common native subterranean species.

	Formosan	**R. flavipes**	**R. virginicus**	**R. hageni**
Body Size	12-15 mm (0.5 – 0.6 in.)	8-10 mm (0.3 – 0.4 in)	4.5-5 mm (0.1 – 0.2 in)	4.5-5 mm (0.1 – 0.2 in)
Body Color	Light yellow-brown	Black	Black	Light yellow-brown
Wings	Covered with fine hairs	No hairs	No hairs	No hairs
Wing size	> 11 mm (0.4 in)	8-9 mm (0.3 in)	6.5-7.5 mm (0.25 in)	6-7 mm (0.2 in)
Flight times	May – July Night	Feb – April Day	May-June Day	August Day
Antennal Segments	Greater than 20	Less than 20	Less Than 20	Less than 20

Soldiers

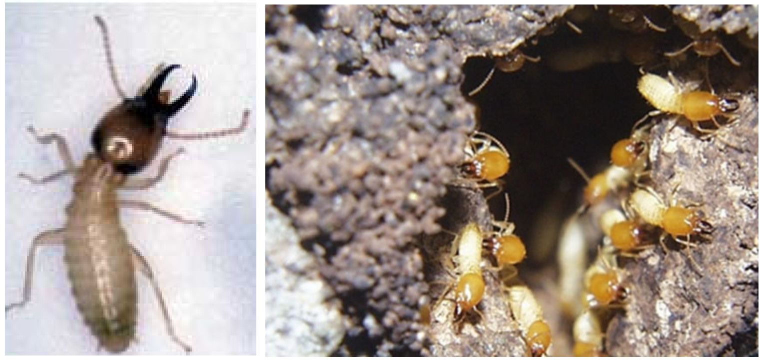
Soldiers of the Formosan termite have an oval-shaped head compared to the oblong shape of the native subterranean soldiers. In addition, the Formosan soldiers have a well-developed fontanelle which forms a tube-like structure on the front margin of the head just above the mandibles. When disturbed, the soldiers emit a milky white fluid from this opening; whereas native termite soldiers do not eject any noticeable substance. The proportion of soldiers to workers in native subterranean termite colonies is approximately 1-2 to 100 (1-2%), in contrast to the Formosan termite colony which contains 10-20 soldiers for every 100 workers (10-20%).

Damage
Subterranean termites most commonly live in the soil where they can avoid temperature extremes and obtain the moisture essential to their existence. Rather than building a discreet nest like their tropical cousins, subterranean termites construct numerous scattered nursery areas where reproductives are found together with piles of eggs and young termites. These nursery areas can be in buried stumps, logs, dead roots or pieces of lumber left in the backfill after building construction. Nursery areas can also be found in the wood of structures. These areas can be as far down as 3 to 6 m below ground level.

Because subterranean termites can get moisture from the soil, they can attack any dry wood or other source of cellulose within foraging distance of the colony. Besides wood structures, subterranean termites will attack untreated fence posts and attached boards, utility poles, and any other food sources such as cardboard, paper, or fiberboard in, on, or close to the ground.

They prefer to feed on the softer spring growth of infested wood, leaving the harder summer wood and a paper-thin outer shell of wood. Termite nursery areas located under sub-floors or concrete slabs near furnaces, water heaters or other sources of heat can remain active during the winter. Where a wood source is not in contact with the soil, workers will build earthen '*shelter tubes*' over concrete foundation walls or in cracks in the concrete through which they can travel to and from the food source and soil moisture. Occasionally, the tubes can be built downward from a wood member to the ground. The tubes provide protection from predators, especially ants, which are mortal enemies of termites.

Besides gaining entry via wood touching or close to the ground, termites can enter through cracks in concrete foundations and slabs, and through spaces around utility pipes cut through cement foundations. Workers have been observed following the roots of spreading junipers under landscape cloth covered with bark mulch or wood chips. This environment also provides protection from ants and high temperatures. Workers will also feed on wood chips in contact with soil.



Formosan termite left and a colony, right.

The Formosan Infestation Map is a made possible through the cooperation of PCOs, state associations, state regulatory officials and termite researchers. It is continuously updated, so please return to the LIPCA web site often.

Assessing Wood Damage

Termite damage to the wood's surface often is not evident because termites excavate galleries within materials as they feed. Wood attacked by subterranean termites generally has a honeycombed appearance because termites feed along the grain on the softer spring growth wood. Their excavations in wood often are packed with soil, and fecal spotting is evident.

When inspecting for termites, it is useful to probe wood with a knife or flat blade screwdriver to detect areas that have been hollowed. Severely damaged wood may have a hollow sound when it is tapped.

Again, Subterranean termites do not reduce wood to a powdery mass, and they do not create wood particles or pellets, as do many other wood-boring insects.

Mass Emergence
The mass emergence of winged termites in the spring is often the first sign of an infestation. In the majority of cases, they emerge in homes near sources of heat - furnaces or water heaters. The appearance of winged termites means that the infestation has been around for at least 3 or 4 years. Therefore it is likely some damage has already been done, so it is important to find where the termites have been feeding, how much damage has been done, and how much repair is needed.

A qualified professional termite control service should be hired to apply an appropriate termiticide to protect the building from further damage. Other means of detecting infestations include knocking on walls, floors, sub-floor wood, joists, etc. and listening for the tapping of soldiers, and looking for shelter tubes on the outside of the building and under the sub-floor.

Because subterranean termites have a constant demand for water, one should closely examine areas near moist soil, such as below dripping outside faucets, leaking underground sprinkler pipes and nozzles, and below downspouts.

Where damage or termites are suspected, prod with a sharp narrow implement to check the soundness of the supporting wood structure. The detection of termite infestations is best left to professionals who have the experience to do it thoroughly and accurately. Termites can enter a building from one or more points so it is important to locate all points of entry for control purposes.

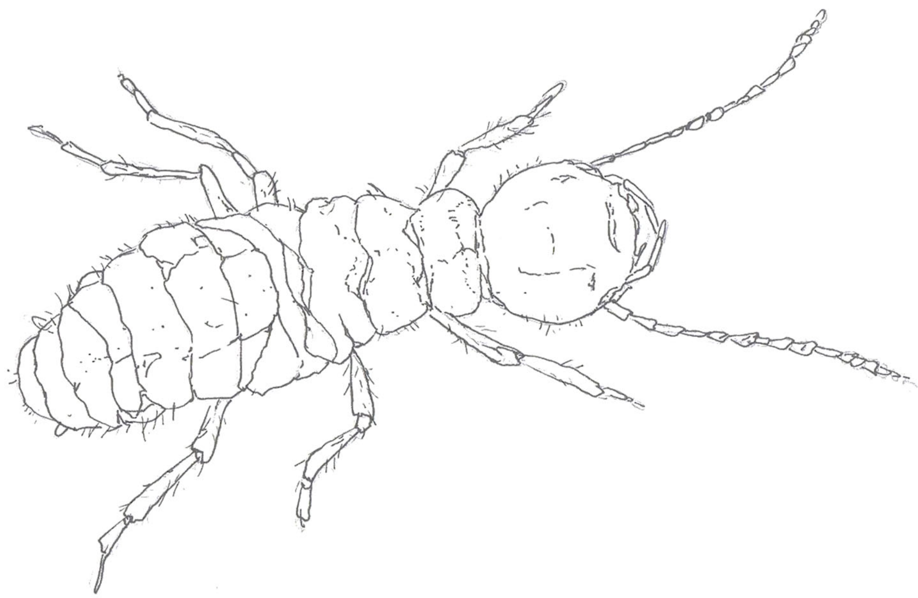
Outdoors, termites can be detected by driving wooden stakes into the ground at varying distances from buildings and other wooden structures. Examine the stakes every 3 months for termites or signs of their feeding damage.

Evidence of Termite Infestations

1. Wood damaged by subterranean termites can be readily penetrated with a screwdriver, ice pick, or knife. The wood easily breaks apart, revealing mud tubes attached to wood galleries or tunnels in an irregular pattern. The tunnels may contain broken mud particles with fecal materials. In the case of an active colony, white termites may be found in infested wood.

2. The presence of winged males, females, or their shed wings, particularly when the adults fly inside the building, indicates an infestation in the building.

3. Another indication is the presence of mud or shelter tubes extending from the ground to woodwork or on foundation walls. Workers travel periodically via shelter tubes to their colony to obtain moisture and perform feeding duties. Workers build mud or shelter tubes from soil and wood particles, and coat them with a glue-like substance that they secrete. Each mud tube is about the diameter of a lead pencil.



SUBTERRANEAN FORMOSAN TERMITE

How Old is the Damage?
Based on normal feeding activity, it takes 3 to 8 years to cause appreciable damage to a structure. There have been some predictions that, under ideal conditions, a termite colony of 60,000 workers may consume a one-foot length of 2" x 4" pine in 118 to 157 days. In the United States, the extent of damage may be less because of a reduction in feeding activity during the cold season.

Termite Inspection Procedure Sub-Section

Applicators may be able to locate termite damage by probing wood with a screwdriver, ice pick, or knife. Start in the basement and use a bright flashlight. Look for mud tubes and the presence of swarmers. Termite damage/activity is often found during building remodeling or repair. Some agencies such as Farmers Home Administration (FHA), Veterans Administration (VA), Housing and Urban Development (HUD), and loan companies require termite inspections during real estate transfers. If necessary, seek help from professional pest control operators or experienced entomologists.

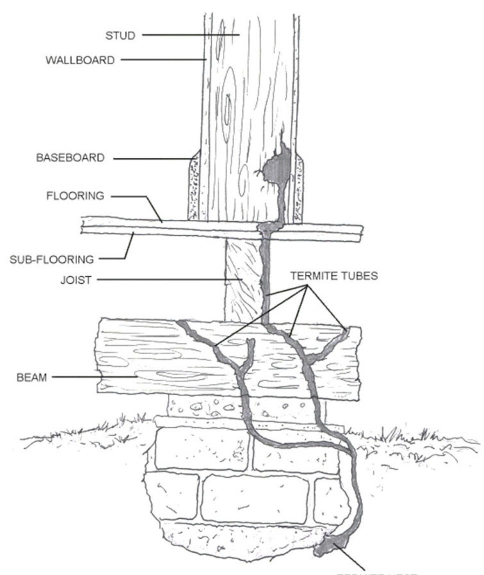
You as professional pesticide applicator should inspect exterior and interior foundation surfaces, particularly construction where wood is on or near the soil.

Mud tubes are solid evidence of termite activity. Other inspection sites are:

1. Wood construction in basement and crawl space (if present).
2. Sills, joists, support posts, basement window frames, wood under porches.
3. Hollow blocks, cracks in concrete or brick construction and expansion joints.
4. Scrap wood on ground, old tree stumps, fence posts, and exterior frames of basement windows.

Useful Information If Treatment is Necessary

If termite activity is suspected or found and an insecticide treatment is necessary, it is important to outline the plan of the building, indicating sites of termite activity and treatment procedures. Building owners/managers are encouraged to seek two or more inspections and cost estimates. Ask for information on chemical treatment procedures, repair of woodwork, warranties, copies of the insecticide label, and other pertinent information. Compare bids before making decisions. Ask for proof of liability insurance.



Control Objectives

The goal is to establish a continuous insecticide barrier between the termite colony (usually in the ground) and the wood in a building. Sometimes a secondary termite colony may exist above ground (in roof or other areas with a constant moisture supply) which requires additional treatment.

General Treatment Guidelines

Insecticide barriers are generally established during:

1. Pre-construction (during construction).
2. Post-construction (existing building). In an existing building, termite treatments may involve any of the following: a) mechanical alterations, and b) use of an insecticide for treating the soil, foundation, and wood.

In most cases, an untrained homeowner or building manager should not attempt a termite treatment.

Generally, termite treatments should be performed by professional pest control operators (PCOs), however, most termite chemicals or products are easily obtainable on Amazon or the Internet, thus providing access to chemicals to the public or handymen.

Termite ground or slab treatment requires special tools such as hammer drills, sub-slab injectors, rodding devices, high pressure pumps, a power supply, protective equipment. Several insecticides are registered in United States for termite control (Table 1 in a few more pages).

All of these insecticides control termites if properly applied. We will carefully study ground treatment in this course.

The procedures described here are general guidelines, and the applicator must follow the insecticide label directions for dilution, application rate, and other relevant information.

Caution

1. Do not apply insecticides when soil is frozen or water-soaked (saturated). Frozen or saturated soil will not permit adequate absorption for even distribution of insecticide.
2. Do not permit humans and pets to contact treated surfaces until dry.
3. Before using insecticides for termite control, always read, understand and follow all label directions.
4. Keep all pesticides in original containers, out of reach of children and do not contaminate food, feed and water.
5. Do not plant garden food crops in treated soil.
6. Do not allow children and pets to play in treated soil.

Pre-Construction Treatment

Horizontal Barriers: In general, treat the footing trench with insecticide before pouring cement footings. After grading is completed, apply diluted insecticide to areas before pouring slab floors, slab-supported porches, patios, carports, and entrance platforms at the rate of 1 gallon per 10 square feet.

Vertical Barriers: Establish a chemical barrier in areas such as around the bases of foundations, plumbing, utility entrances, and backfilled soil against foundation walls. Treat crawl space areas either by rodding or trenching procedures. To produce a vertical barrier in soil, apply insecticide at the rate of 4 gallons per 10 linear feet per foot of depth. After treatment, cover the crawl space area with a layer of untreated soil or polyethylene sheeting.

Post-Construction Treatment
Do not apply insecticides until locations of radiant heat pipes, water pipes, sewer lines, and electrical conduits are identified.

Buildings requiring treatment generally fall into three categories:
a) building on slab construction,
b) building with crawl space, and
c) building with a basement.

There is a common belief that termites cannot penetrate slab foundations. Termites cannot penetrate solid concrete but they can enter through cracks as small as 1/64 of an inch.

Building on Slab
Controlling termite infestation in a building on a slab is especially difficult and hazardous. In this type of construction, heat ducts (pipes) are buried in the concrete and serious damage can occur when they are accidentally drilled for holes to inject insecticide solutions. Drilling through electrical conduits or plumbing imbedded in the floor is another problem.

Treat the exterior of the foundation by digging a narrow and shallow trench about 6 inches wide along the outside of the foundation. Apply the diluted insecticide to the trench and soil at the rate of 4 gallons per 10 linear feet. Cover treated soil in the trench with a thin layer of untreated soil. For an inside barrier, drill slab and space holes about 1 foot apart and 6 inches from the wall.

Sub-slab injector.

Using a subslab injector, inject insecticide through holes at the rate of 4 gallons per 10 linear feet. After application, plug all holes with mortar or any other special compound.

Table 1. Insecticides commonly used for subterranean termite control (check with your State for restrictions)

Brand or trade names	Generic or common names	Dilution rates	Manufacturers
Available to professional pest control companies			
Demon TC	cypermethrin	0.25%	ICI Chemical Co.
Dragnet FT	permethrin	0.5-1%	FMC Chemical Co.
Dursban TC	chlorpyrifos	0.5-1%	Dow-Elanco Co.
Equity	chlorpyrifos	0.5-1%	Dow-Elanco Co.
Ficam[a]	bendiocarb	0.25%	Nor-Am Chem. Co.
Prevail FT[b]	cypermethrin	0.3-0.6%	FMC Chemical Co.
Pyrfon 6	isofenphos	0.75%	Mobay Chemical Co.
Torpedo	permethrin	0.5-1%	ICI Chemical Co.
Tribute	fenvalerate	0.5-1%	Roussel Bio Corp.
Available to general public			
Orthoklor Soil Insect & Termite Killer	chlorpyrifos	0.5%	Chevron Chem. Co.
Black Leaf Termite Killer	chlorpyrifos	0.5%	Black Leaf Products
Chlor-Guard Termite Preventor	chlorpyrifos	0.5%	Security Products

[a]Registered for spot treatment only
[b]Registered for pre-construction treatment only

We will go more into detail in the Advance Treatment Section.

This course contains EPA's federal rule requirements. Please be aware that each state implements pesticide regulations that may be more stringent than EPA's regulations and these frequently are changed. Check with your state environmental/pesticide agency for more information.

Types of Pesticide Spectrums

Broad-Spectrum
A pesticide that is effective against many pest. An example of a broad-spectrum pesticide is methyl bromide, which is designed to control pests ranging from small insects and pathogens to larger weeds and rodents. The pesticide can be injected into the ground to kill organisms in the soil that might harm the plant while it is growing. It can also be pumped into warehouses or barns to kill pests that could harm the plant during storage or transport for sale.

Narrow-Spectrum AKA Target-Spectrum
Developed to kill specific organism types. An example of a narrow-spectrum pesticide is chitin inhibitors, which are chemicals that interact with chitin, a component of the exoskeleton of insects. This pesticide inhibits the development of chitin and will eventually result in the death of the insect. The chitin inhibiting pesticide will only harm insects that have chitin in their exoskeletons and will not affect other insects.

Adjuvants - Primary Types

A pesticide adjuvant is broadly defined as any substance added to the spray tank, separate from the pesticide formulation, that will improve the performance of the pesticide.

Diluent: A substance used to dilute something.
Fillers: A diluent in Powder form.
Spreaders: A substance that is added to assist even distribution over the target.
Surfactants: Chemicals that physically alter the surface tension of a spray droplet.
Wetting Agent: A chemical added that can be added to a liquid to reduce its surface tension and make the chemical more effective in spreading over and penetrating surfaces.

Topic 3 – Termite Introduction Post Quiz
Answers in Rear after the Glossary

Termites
1. Which species of termites are the most destructive of all termite species, account for 95% of the damage?

2. Workers are creamy white, soft-bodied, wingless, and blind.
True or False

3. Flying ants and swarming termites are often difficult to distinguish when these insects are seen around residential and commercial buildings.
True or False

Termite Life
4. The single female can easily start a new colony on her own. Establishment of a colony is dependent upon the survival of both the queen in the nest site and that she has successfully mated.
True or False

Communication in the Colony
5. Western subterranean termite workers look like white or cream-colored ants. Swarmers are about 3/8-inches long (wings included), and their body is dark brown. They have two pairs of wings, and the front wings are larger than the hind wings. Soldiers have an orange, rectangular-shaped head with large pincher- like mouthparts that are used to fight off colony invaders.
True or False

6. Ants have one pair of transparent wings with many veins and are of equal length, and often have a light patch along the outer margin of the front wing, whereas the wings of termites are about equal in length (8-9 mm) and have many fine veins.
True or False

7. Western subterranean termites have acute survival instincts. If they are shaken up or disturbed, the termites often will abandon the associated area and move on to secretly cause damage in other areas in the building.
True or False

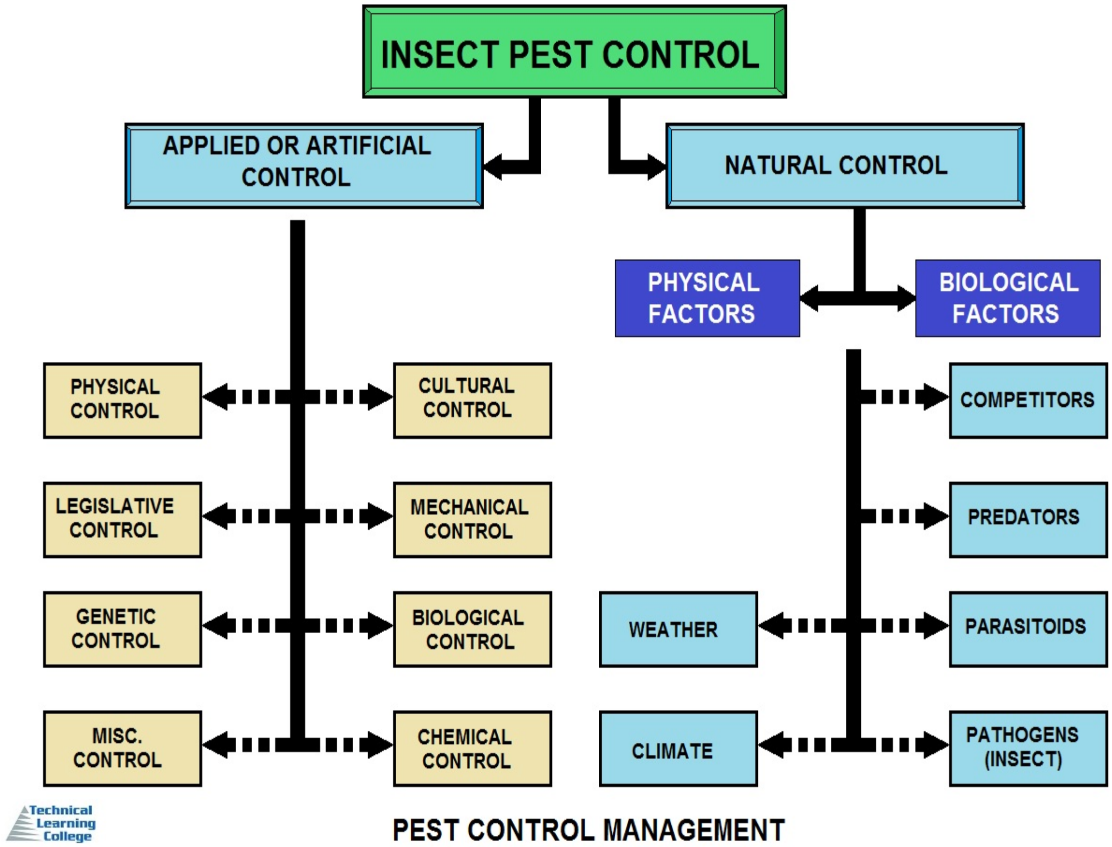
8. Which termite species termite’s colonies are relatively small, with a few thousand members lacking the true worker caste, and there are often multiple colonies in the same structure?

9. Which termite species termite’s colony consists of three castes: reproductives, soldiers and nymphs? Winged reproductive, or alates, are almost one-inch long and their color ranges from yellowish-brown to cinnamon-brown.

10. Which termite species does not build mud shelter tubes above the ground in order to reach wood?

Topic 4 – Ant and Termite Management

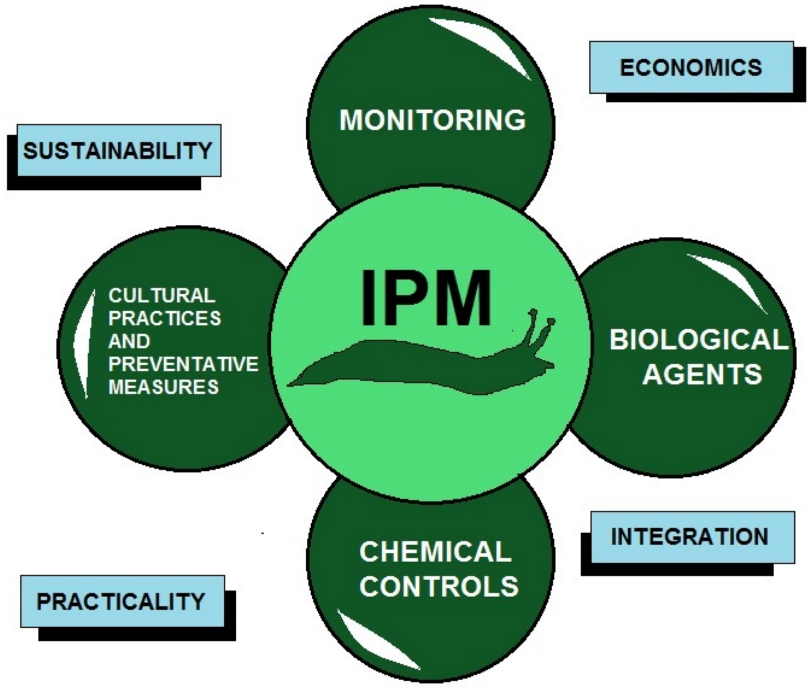
Topic 4- Section Focus: You will learn the fundamentals of ant and termite management and control techniques. At the end of this section, you will be able to understand and describe pest management, control and elimination techniques of ants and termites. There is a post quiz at the end of this section to review your comprehension and a final examination in the Assignment for your contact hours.



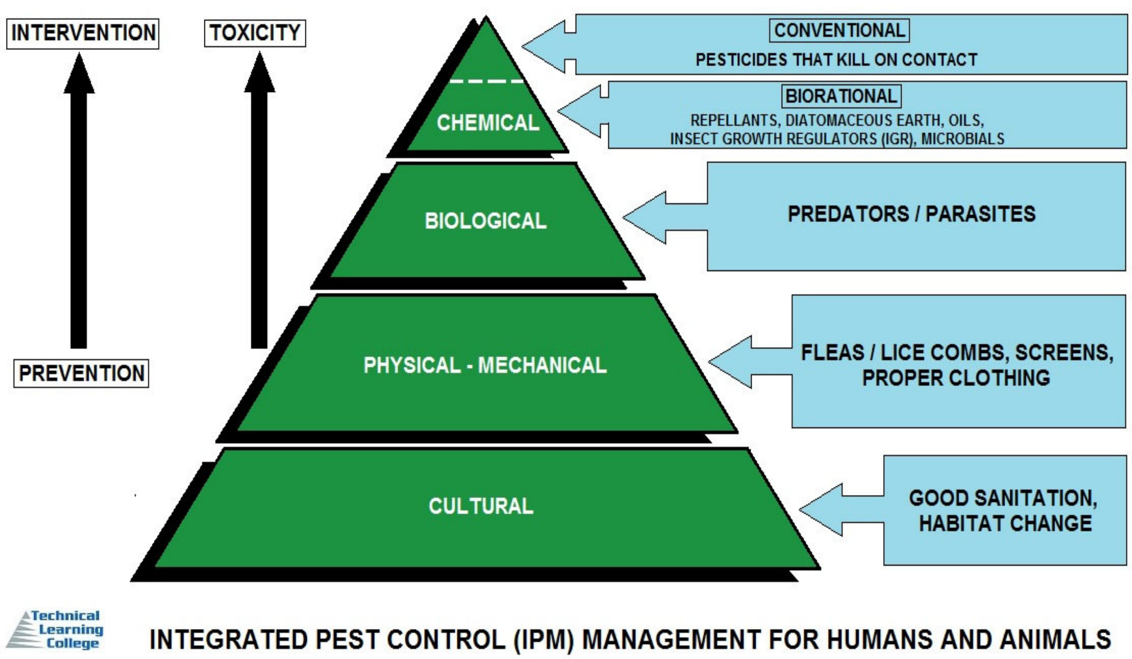
Termiticide Examples

Although this information is not on the label, most of the time, termite treatments will destroy most ants. Therefore, we will take a quick look at examples of termiticides used for soil treatment including cypermethrin, fipronil, fenvalerate, imidacloprid and permethrin.

Any of these can be used to establish a chemical barrier that destroys or repels termites. Label directions for these materials should be followed closely for the concentration and rate of application to be used. The judgment and experience of the termite specialist is important when selecting the termiticide that best suits the particular type of construction and the soil conditions. Below are descriptions of the various products and classes of chemicals that can be used in termite control.



INTEGRATED PEST MANAGEMENT COMPONENT DIAGRAM



INTEGRATED PEST CONTROL (IPM) MANAGEMENT FOR HUMANS AND ANIMALS

Pyrethroids

The pyrethroids are a large family of modern synthetic insecticides similar to the naturally derived botanical pyrethrins. They are highly repellent to termites, which may contribute to the effectiveness of the termiticide barrier. They have been modified to increase their stability in the natural environment. They are widely used in agriculture, homes, and gardens. Some examples are bifenthrin, cyfluthrin, cypermethrin, deltamethrin, and permethrin. They may be applied alone or in combination with other insecticides. Pyrethroids are formulated as emusifiable concentrates (EC), wettable powders (WP), granulars (G), and aerosols.

Certain pyrethroids exhibit striking neurotoxicity in laboratory animals when administered by intravenous injection, and some are toxic by the oral route. Systemic toxicity by inhalation and dermal absorption are low, however—there have been very few systemic poisonings of humans by pyrethroids. Though limited absorption may account for the low toxicity of some pyrethroids, rapid biodegradation by mammalian liver enzymes (ester hydrolysis and oxidation) is probably the major factor responsible.

This publication contains pesticide recommendations that are subject to change at any time. These recommendations are provided only as a guide. It is always the pesticide applicator's responsibility, by law, to read and follow all current label directions for the specific pesticide being used. Due to constantly changing labels and product registration, some of the recommendations given in this writing may no longer be legal by the time you read them. If any information in these recommendations disagrees with the label, the recommendation must be disregarded.

No endorsement is intended for products mentioned, nor is criticism meant for products not mentioned. The author and Technical Learning College (TLC) assume no liability resulting from the use of these recommendations.

Most pyrethroid metabolites are promptly excreted, at least in part, by the kidney. In response to dermal exposure, some persons may experience a skin sensitivity called paresthesia. The symptoms are similar to sunburn sensation of the face and especially the eyelids. Sweating, exposure to sun or heat, and application of water aggravate the disagreeable sensations. This is a temporary effect that dissipates within 24 hours.

First Aid

For first aid, wash with soap and water to remove as much residue as possible, and then apply a vitamin E oil preparation or cream to the affected area. Paresthesia is caused more by pyrethroids whose chemical makeup includes cyano- groups: fenvalerate, cypermethrin, and fluvalinate. In addition to protecting themselves from future exposure, persons who have experienced paresthesia should choose a pyrethroid with a different active ingredient, as well as a wettable powder or microencapsulated formulation.

About These Pesticides

Pyrethrins and pyrethroids are insecticides included in over 3,500 registered products, many of which are used widely in and around households, including on pets, in mosquito control, and in agriculture. The use of pyrethrins and pyrethroids has increased during the past decade with the declining use of organophosphate pesticides, which are more acutely toxic to birds and mammals than the pyrethroids. This change to less acutely toxic pesticides, while generally beneficial, has introduced certain new issues.

For example, residential uses of pyrethrins and pyrethroids may result in urban runoff, potentially exposing aquatic life to harmful levels in water and sediment.

Pyrethrins are botanical insecticides derived from chrysanthemum flowers most commonly found in Australia and Africa. They work by altering nerve function, which causes paralysis in target insect pests, eventually resulting in death.

Pyrethroids are synthetic chemical insecticides whose chemical structures are adapted from the chemical structures of the pyrethrins and act in a similar manner to pyrethrins. Pyrethroids are modified to increase their stability in sunlight.

Most pyrethrins and some pyrethroid products are formulated with synergists, such as piperonyl butoxide and MGK-264, to enhance the pesticidal properties of the product.

These synergists have no pesticidal effects of their own but enhance the effectiveness of other chemicals.

Pyrethrins, a single pesticide active ingredient, contain six components that have insecticidal activity: pyrethrin 1, pyrethrin 2, cinerin 1, cinerin 2, jasmolin 1, and jasmolin 2

Pyrethroids include:
Allethrin stereoisomers, Bifenthrin, Beta-Cyfluthrin, Cyfluthrin, Cypermethrin, Cyphenothrin, Deltamethrin, Esfenvalerate, Fenpropathrin, Tau-Fluvalinate, Lambda-Cyhalothrin, Gamma Cyhalothrin, Imiprothrin, 1RS cis-Permethrin, Permethrin, Prallethrin, Resmethrin, Sumithrin (d-phenothrin), Tefluthrin, Tetramethrin, Tralomethrin, and Zeta-Cypermethrin

Synergists include:MGK-264 and Piperonyl butoxide

Permethrin

General Information
Permethrin is a broad-spectrum pyrethroid insecticide. It is available in dusts, emulsifiable concentrates, smokes, ULV concentrates, and wettable-powder formulations.

The historical development of the synthetic pesticides called pyrethroids is based on the pyrethrins, which are derived from chrysanthemums. Pyrethrins are a "natural" environmental product that is of low toxicity to mammals. They are highly photolabile and degrade quickly in sunlight, and the cost of reapplying them has limited their widespread agricultural use. Pyrethroids have been synthesized to be similar to pyrethrins yet more stable in the environment. Evidence suggests that they have a very large margin of safety when used as directed by the label (Aldridge, 1990; Chen et al., 1991; Snodgrass, 1992).

Commercial pyrethroid products commonly use petroleum distillates as carriers. Some commercial products also contain OP or carbamate insecticides because the rapid paralytic effect of pyrethrins on insects ("quick knockdown") is not always lethal (Cheremisinoff and King, 1994). Pyrethroids are formulated as emulsifiable concentrates, wettable powders, granules, and concentrates for ULV application.

Borates

"Borate" is a generic term for compounds containing the elements boron and oxygen. Boron never occurs alone naturally but as calcium and sodium borate ores in several places in the world.

Borax and other sodium borates are used in numerous products such as laundry additives, eye drops, fertilizers, and insecticides. Though the mechanisms of toxicity are not fully understood, boron is very toxic to insects and decay fungi that commonly damage wood in structures. At low levels, however, boron is only minimally toxic, and perhaps beneficial, to humans, other mammals, and growing plants. Use of borate-treated wood for construction of homes and their wood-based contents appears to offer many advantages to today's environmentally sensitive world.

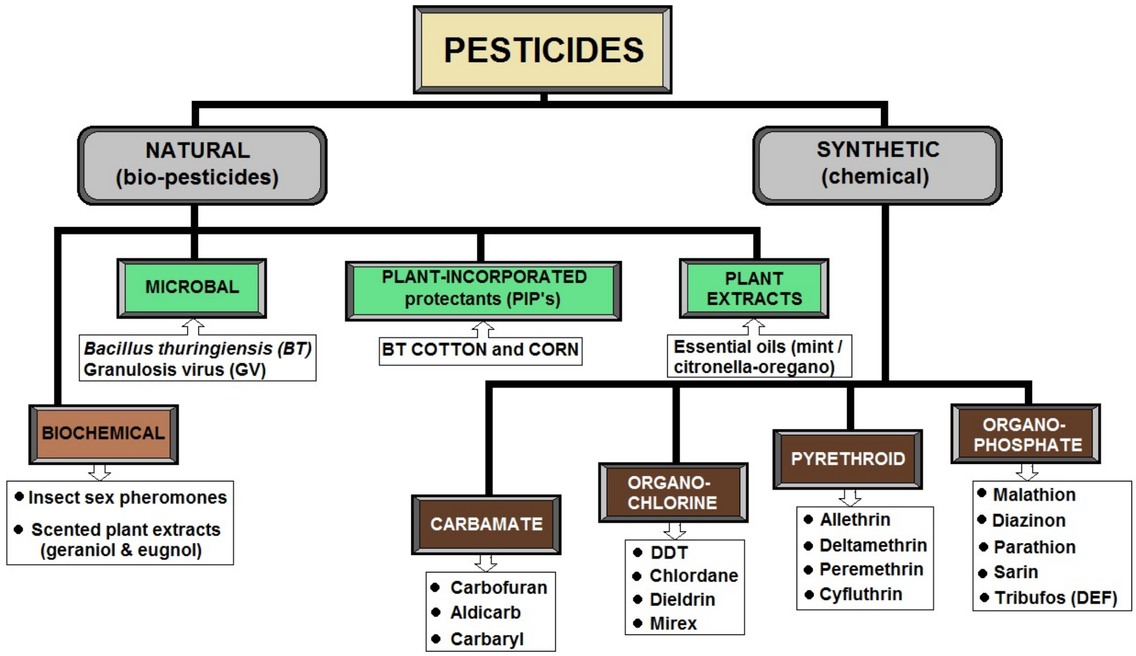
Unlike most other wood preservatives and organic insecticides that penetrate best in dry wood, borates are diffusible chemicals—they penetrate unseasoned wood by diffusion, a natural process. Wood moisture content and method and length of storage are the primary factors affecting penetration by diffusion. Properly done, diffusion treatments permit deep penetration of large timbers and refractory (difficult-to-treat) wood species that cannot be treated well by pressure.

The diffusible property of borates can be manipulated in many ways; suitable application methods range from complex automated industrial processes to simple brush or injection treatments.

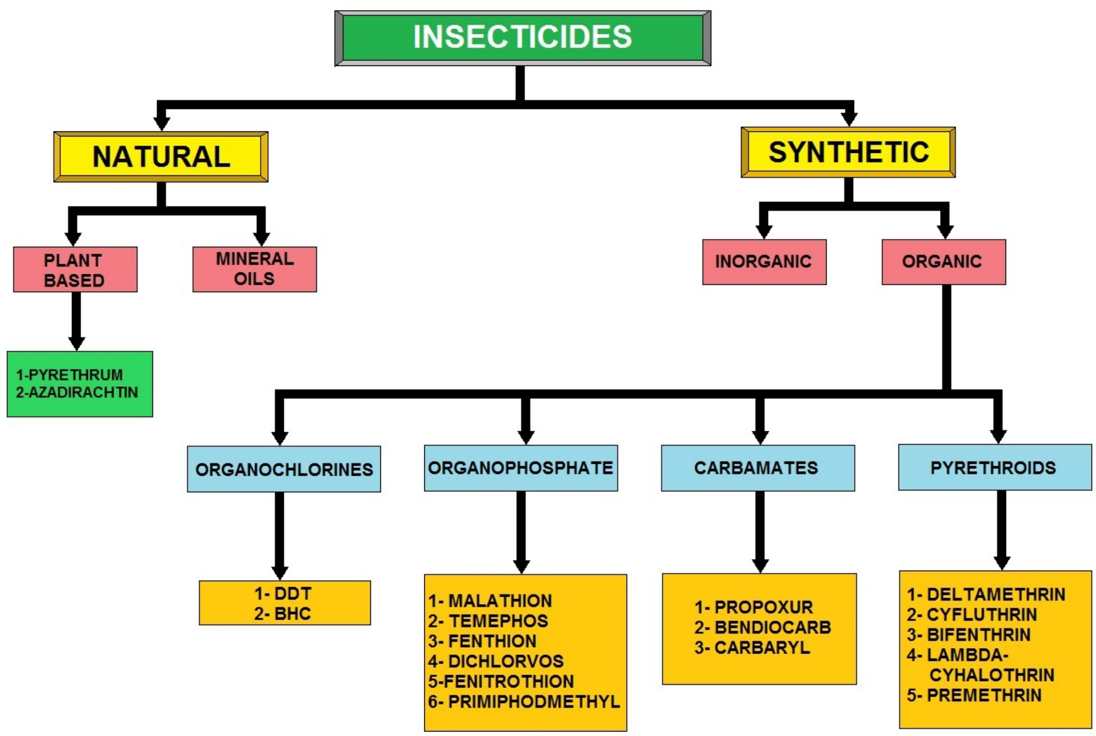
Application methods include momentary immersion by bulk dipping; pressure or combination pressure/diffusion treatment; treatment of composite boards and laminated products by treatment of the wood finish; hot and cold dip treatments and long soaking periods; spray or brush-on treatments with borate slurries or pastes; and placement of fused borate rods in holes drilled in wood already in use.

This publication contains pesticide recommendations that are subject to change at any time.

These recommendations are provided only as a guide. It is always the pesticide applicator's responsibility, by law, to read and follow all current label directions for the specific pesticide being used. Due to constantly changing labels and product registration, some of the recommendations given in this writing may no longer be legal by the time you read them. If any information in these recommendations disagrees with the label, the recommendation must be disregarded. No endorsement is intended for products mentioned, nor is criticism meant for products not mentioned. The author and Technical Learning College (TLC) assume no liability resulting from the use of these recommendations.



DIFFERENT CLASSIFICATIONS OF PESTICIDES



PESTICIDES BASED UPON CHEMICAL COMPOSITION

Organophosphates and Carbamates Pesticides

Organophosphates are phosphoric acid esters or thiophosphoric acid esters. When developed in the 1930s and 1940s, their original compounds were highly toxic to mammals. Organophosphates manufactured since then are less toxic to mammals but toxic to target organisms, such as insects. Malathion, dibrom, chlorpyrifos, temephos, diazinon and terbufos are organophosphates. Carbamates are esters of N-methyl carbamic acid. Aldicarb, carbaryl, propoxur, oxamyl and terbucarb are carbamates.

Although these pesticides differ chemically, they act similarly. When applied to crops or directly to the soil as systemic insecticides, organophosphates and carbamates generally persist from only a few hours to several months. However, they have been fatal to large numbers of birds on turf and in agriculture, and negatively impacted breeding success in birds. Many organophosphates are highly toxic to aquatic organisms.

These are two very large families of insecticides. Indeed, they have been the primary insecticides for the past 25 to 30 years. They range in toxicity from slightly to highly toxic. They are formulated in all kinds of ways from highly concentrated emulsifiable concentrates (ECs) to very dilute granular (G) formulations.

These insecticide families are similar in their modes of action—they are all nervous system poisons. Insects and all other animals, including humans, have nervous systems that are susceptible. Both insecticide families are efficiently absorbed by inhalation, ingestion, and skin penetration. To a degree, the extent of poisoning depends on the rate at which the pesticide is absorbed.

Organophosphates break down chiefly by hydrolysis in the liver; rates of hydrolysis vary widely from one compound to another. With certain organophosphates whose breakdown is relatively slow, significant amounts may be temporarily stored in body fat. The organophosphates and carbamates replaced the chlorinated hydrocarbons (e.g., chlordane, aldrin, and heptachlor) for all uses, including termite control. Examples of organophosphates are chlorpyrifos for termite control and diazinon for other household pests. An example of a carbamate is carbaryl, also used for household and lawn pests.

How can people be exposed to organophosphate and carbamate pesticides?
People can be exposed to organophosphates and carbamates pesticides through accidental exposure during use. People can accidentally inhale the pesticides if they are in an area where they were recently applied. The chemicals can be ingested with food or drinks that are contaminated.

How can these pesticides exhaust affect my health?
Acetylcholinesterase is an enzyme found in the nervous system, red blood cells and blood plasma. These pesticides damage nerve function by acting as acetylcholinesterase inhibitors in the nervous system.

Breathing - Short-term exposure can produce muscle twitching, headache, nausea, dizziness, loss of memory, weakness, tremor, diarrhea, sweating, salivation, tearing, constriction of pupils, and slowed heartbeat.

Long-term exposure can produce delayed neurotoxicity, such as tingling and burning in the extremities. This delayed neurotoxicity can progress to paralysis and is seldom reversible. Damage to the liver, kidney, immune system and bone marrow may occur. Some carbamates are also suspected carcinogens.

What should I do if exposed to these pesticides?
If you think you were exposed to these pesticides, contact your doctor.

Is there a medical test to show whether I was exposed to these pesticides?
The level of cholinesterase activity in red blood cells or plasma helps physicians determine exposure to these pesticides.

However, other chemicals or disease states can alter acetylcholinesterase activity. Urine or blood tests only apply if a person was exposed to a large quantity. Persons who will use these pesticides regularly should ask their physician to establish a baseline value prior to prolonged use, followed by monthly monitoring.

Pesticide Poisoning
Insecticides cause the greatest number of pesticide poisonings in the United States. The most serious pesticide poisonings usually result from acute exposure to organophosphate and carbamate insecticides.

Organophosphate Insecticides
Organophosphate insecticides include chlorpyrifos, diazinon, dimethoate, disulfoton, malathion, methyl parathion, and ethyl parathion. The carbamate compounds include carbaryl, carbofuran, methomyl, and oxamyl. Organophosphates and carbamates inhibit the enzyme cholinesterase, causing a disruption of the nervous system. All life forms with cholinesterase in their nervous system, such as insects, fish, birds, humans, and other mammals, can be poisoned by these chemicals.

Seeking Medical Attention 1-800-222-1222

If you are having symptoms but are unsure if they are pesticide related, at least notify someone in case your symptoms become worse. Nevertheless, when symptoms appear after contact with pesticides, you should seek medical attention immediately.

At this time, call the **National Poison Center at 1-800-222-1222** for guidance on the proper response to your symptoms. This number will direct your call to the nearest poison center, which is staffed on a 24-hour basis.

Pyrroles

Chlorfenapyr is the only termiticide from the pyrrole family of chemistry and is active primarily as a stomach poison with some contact activity. It is also non-repellent to termites. Chlorfenapyr is registered as a termiticide under the tradename Phantom®.

Chlorfenapyr acts on the mitochondria of cells and uncouples or inhibits oxidative phosphorylation, preventing the formation of the crucial energy molecule adenosine triphosphate (ATP). As a result, energy production in the cells shuts down, resulting in cellular and, ultimately, termite death.

This course contains EPA's federal rule requirements. Please be aware that each state implements pesticide regulations that may be more stringent than EPA's regulations and these frequently are changed. Check with your state environmental/pesticide agency for more information.

Fiproles (or Phenylpyrazoles)

Fipronil is the only insecticide in this new class, introduced in 1990 and registered in the U.S. in 1996. It is marketed as a termiticide under the tradename Termidor®. This termiticide is a non-repellent material with contact and stomach activity. Fipronil works by blocking the gamma-aminobutyric acid (GABA) regulated chloride channel in neurons, thus disrupting the activity of the insect's central nervous system.

Pesticide Poisoning
Insecticides cause the greatest number of pesticide poisonings in the United States. The most serious pesticide poisonings usually result from acute exposure to organophosphate and carbamate insecticides.

Seeking Medical Attention 1-800-222-1222

If you are having symptoms but are unsure if they are pesticide related, at least notify someone in case your symptoms become worse. Nevertheless, when symptoms appear after contact with pesticides, you should seek medical attention immediately.

At this time, call the **National Poison Center at 1-800-222-1222** for guidance on the proper response to your symptoms. This number will direct your call to the nearest poison center, which is staffed on a 24-hour basis.

BIOLOGICAL CONTROL METHODS

FOUR AREAS OF BIOLOGICAL PEST CONTROL

(1) USING INSECT'S NATURAL ENEMIES

SELECTIVITY INCREASING THE POPULATION OF INSECT'S NATURAL ENEMIES

(2) RESISTANT PLANT VARIETIES

USING PLANT VARIETIES, NATURAL OCCURING & BY GENTIC RESEARCH, RESISTANT TO INSECT

(3) CROP ROTATIONS

ROTATING THE TYPE OF CROP GROWN IN A PARTICULAR SPOT, SO SAME CROP IS NOT GROWN CONTINUOUSLY

(4) STERILIZATION

USE CHEMICALS OR RADIATION TO STERILIZE OR TO GENETICALLY ALTER INSECTS SO THEY ARE UNABLE TO REPRODUCE

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Insect Growth Regulators - Introduction

An insect growth regulator (IGR) is a synthetic chemical that mimics insect hormones. Hormones regulate a wide array of body and growth (physiological) functions. IGRs may interfere with molting, pupal emergence, or body wall formation. IGRs are often specific for an insect species or a group of very closely related species. They often have delayed effects because they are taken into the insect and stored until the insect reaches the right growth stage. This may range from days to weeks or even months. For example, if the IGR stops the insect from molting and a given insect is exposed just after a molt, it would continue to function normally until the next molt before dying.

In the case of termite control, the slow action of the IGR allows the chemical to be widely spread throughout the colony as the termite workers feed and groom one another. IGRs are, in general, environmentally safe and have very low mammalian toxicity. Some examples are hexaflumuron, diflubenzuron, pyriproxyfen, and methoprene.

Biotermiticides
Biotermiticides — such as fungi, nematodes, bacteria, and so forth—still need further research and development to maximize their potential. Metarhizium anisopliae can be injected into galleries, infested walls, and other moist areas where the humidity accelerates the fungal growth. Several forms of nematodes are sold for termite suppression. Nematodes are applied to the soil or directly into mud tubes. As with all new methods of control, more research is needed to determine the advantages and limitations of such organisms.

Biotermiticide, which is derived from fungi, bacteria or nematodes, is injected into active gallery sites. It then develops on the infected foraging termites and spreads among the colony. Suitable temperature and moisture, early detection and avoidance are factors that determine this treatment's success. It may provide localized area control or, with optimum conditions, may suppress a colony.

Nematodes are roundworms, or threadworms (the Greek word *nema* means thread) in the phylum Nematoda. Some species live as parasites inside the bodies of insects and other organisms, often with no observable effect on the hosts. Others cause effects ranging from minor discomfort to disease and death.

Entomophilic nematodes have affinities for insect hosts. Entomopathogenic nematodes (EPN) produce observable deleterious effects.

Certain entomopathogenic nematodes (EPN) are efficient biological control agents that can be used against subterranean termites. That fact has been obscured by tests that emphasized soil-drench (inundative) treatment methods. Recent tests using EPN as inoculums in specially-designed nematode-optimized termite interceptors show that they reliably suppress even large, vigorous termite colonies.

Because EPN do not elicit complex avoidance reactions in termites exposed to them, repeated inoculations in such devices should succeed, over time, in eliminating termite colonies entirely. Furthermore, EPN should perform well as termite colony inoculants in all climates and environments suitable for termite propagation, without the need for exotic toxicant adjuncts.

Among the insect growth regulators are juvenile hormone analogs (JHA), juvenile hormone mimics (JHM) and chitin synthesis inhibitors (CSI). These products disrupt the termites by causing a specific response or behavior within the colony or by blocking the molting process. Remember that all insects, including termites, have an exoskeleton made primarily of chitin. In order to grow, they must periodically shed their chitinous exoskeletons and form new ones. This process is called molting. A chitin synthesis inhibitor slowly builds up in the termite and, the next time a molt should occur, prevents proper formation of the cuticle. IGRs are the slowest of the bait types but have greater impact on the colony.

In some cases, these agents are released into the soil and in other cases they are injected into the above-ground termite galleries. As with all new methods of control, more research is needed to determine the advantages and limitations of such organisms. Bacillus thuringiensis or B.t. is an example of a commonly used biological control agent.

Foaming Agents

Foam formulations of soil-applied termiticides can deliver termiticide to areas difficult to reach with liquid formulations. Borates are foamed for application in wall voids. Foams penetrate into hard-to-reach cavities and voids, and they improve termiticide distribution in soils. The most difficult area to achieve uniform and continuous insecticide distribution is under slabs, where the termite control specialist is unable to see the actual deposition of the termiticide.

Foam applications can reduce the need for corrective treatments, especially under slabs. The liquid termiticide is combined with air to create uniform, small-diameter bubbles. The foam carries the liquid termiticide in the spaces between the bubbles.

As the foam breaks down it leaves a thin residue on the surfaces it had contact with. The fact that foam is less dense than liquid enables it to dispense uniformly. The foaming agent delays collapse of the bubbles, providing more time for the insecticide to reach desired areas. Underneath a slab, gravity deposits most of the liquid on the soil, with a small portion of the residue on other surfaces (such as the underside of a concrete slab) in the treated areas.

Foam treatments do not replace other soil applications (they supplement these applications so that gaps left by conventional treatments can be successfully treated.

Foams are being used to treat—or retreat—critical areas such as unevenly filled porches, which liquids might not reach or cover uniformly. Foams may be used in initial treatments to ensure the most complete termiticide barrier in critical as well as hard-to-reach areas, thus reducing the treatment failures that may occur with the use of soil-applied termiticides alone.

Liquid Formulations

Liquid formulations are generally mixed with water, but in some instances labels may permit the use of crop oil, diesel fuel, kerosene, or some other light oil as a carrier. This section will present more detailed information about the common liquid pesticide formulations.

Aerosols (A)
These formulations contain one or more active ingredients and a solvent. Most aerosols contain a low percentage of active ingredients. There are two types of aerosol formulations: the ready-to-use type commonly available in pressurized, sealed containers and those products used in electric- or gasoline-powered aerosol generators that release the formulation as a "smoke" or "fog."

Liquid Baits
An increasing number of insecticides and rodenticides are being formulated as liquid baits. Liquid rodenticides are mixed with water and placed in bait stations designed for these products. They have two major benefits. Liquid rodenticides are effective in controlling rodents, especially rats, in areas where they cannot find water. They are also effective in areas of poor sanitation where readily available food renders traditional baits ineffective.

Dry or Solid Formulations
Dry formulations can be divided into two types: ready-to-use and concentrates that must be mixed with water to be applied as a spray. This section will present more detailed information about the common dry or solid pesticide formulations. Dusts (D) Most dust formulations are ready to use and contain a low percentage of active ingredients (usually 10% or less by weight), plus a very fine, dry inert carrier made from talc, chalk, clay, nut hulls, or volcanic ash. The size of individual dust particles varies.

Granules (G)
Granular formulations are similar to dust formulations except granular particles are larger and heavier. The coarse particles are made from materials such as clay, corncobs, or walnut shells. The active ingredient either coats the outside of the granules or is absorbed into them. The amount of active ingredient is relatively low, usually ranging from less than 1 to 15 percent by weigh.

Wettable Powders (WP or W)
Wettable powders are dry, finely ground formulations that look like dusts. They usually must be mixed with water for application as a spray. A few products, however, may be applied either as a dust or as a wettable powder; the choice is left to the applicator. Wettable powders contain 5%–95% active ingredient by weight, usually 50% or more. The particles do not dissolve in water. They settle out quickly unless constantly agitated to keep them suspended.

Water-Dispersible Granules (WDG) or Dry Flowables (DF)
Water-dispersible granules, also known as dry flowables, are like wettable powders except instead of being dustlike, they are formulated as small, easily measured granules. Water-dispersible granules must be mixed with water to be applied. Once in water, the granules break apart into fine particles similar to wettable powders. The formulation requires constant agitation to keep them suspended in water. The percentage of active ingredient is high, often as much as 90 percent by weight.

Soluble Powders (SP or WSP)
Soluble powder formulations look like wettable powders. However, when mixed with water, soluble powders dissolve readily and form a true solution. After they are mixed thoroughly, no additional agitation is necessary. The amount of active ingredient in soluble powders ranges from 15% to 95% by weight; it usually is more than 50%.

Soluble powders have all the advantages of wettable powders and none of the disadvantages except the inhalation hazard during mixing. Few pesticides are available in this formulation because few active ingredients are readily soluble in water.

Water-Soluble Packets (WSB or WSP)
Water-soluble packets reduce the mixing and handling hazards of some highly toxic pesticides. Manufacturers package precise amounts of wettable powder or soluble powder formulations in a special type of plastic bag. When you drop these bags into a filled spray tank, they dissolve and release their contents to mix with the water.

Fumigants
Fumigants are pesticides that form gases or vapors toxic to plants, animals, and microorganisms. Some active ingredients are formulated, packaged, and released as gases; others are liquids when packaged under high pressure and change to gases when they are released.

Fumigation
Pests that can be treated with fumigation include drywood termites, Anobiid powder post beetles (usually in softwoods such as floor joists, etc.), Lyctid powder post beetles (sapwood of hardwoods such as moldings, cabinets, and flooring), and old house borers (sapwood of softwoods in beams, rafters, etc.).

Advantages of Fumigation

Fumigation has several advantages over other pest control procedures:

- Fumigants are usually quick acting and eradicate the pest.
- Fumigants diffuse through all parts of the structure or commodity being treated and thus reach pest harborages that cannot be reached with conventional pest control materials or techniques.

For certain pests/commodities, fumigation is the only practical method of control.

Disadvantages of Fumigation
For several reasons, fumigation may not be the best means of pest control:

- The control achieved through fumigation is temporary. There is no residual action from fumigants, and as soon as the fumigation is completed, the structure or commodity is susceptible to re-infestation.
- Fumigants are toxic to humans and special precautions must be taken to protect fumigators and the occupants of fumigated structures.
- Fumigants must be applied in enclosed areas, so application requires additional labor.
- Fumigation must not be attempted by one person. Additional labor is required.

Some commodities or pieces of equipment may be damaged by certain fumigants and must be either removed or protected.

- The special training required for all members of the fumigation crew adds to fumigation costs.
- Occupants of the structure being fumigated usually must vacate the building for a number of hours.
- This may be inconvenient.
- Fumigation requires special licenses and certification.

Termite Bait Application

There are several termite baits on the market that add to the arsenal of tools available for managing termite populations and protecting structures. Baits work on the principle that foraging termites will feed on a treated cellulose material, which eventually kills the termites and possibly the colony. The toxic material in the bait must kill slowly enough to allow foraging termites to return to the colony and spread the bait through food sharing (trophallaxis).

Because dead termites repel other termites, the toxic material also must kill slowly enough so that dead termites do not accumulate near the bait. Baits control a colony locally—either eliminating it or suppressing it to the point that it no longer damages a structure. To be successful, the products must be non-repellent, slow acting and readily consumed by termites.

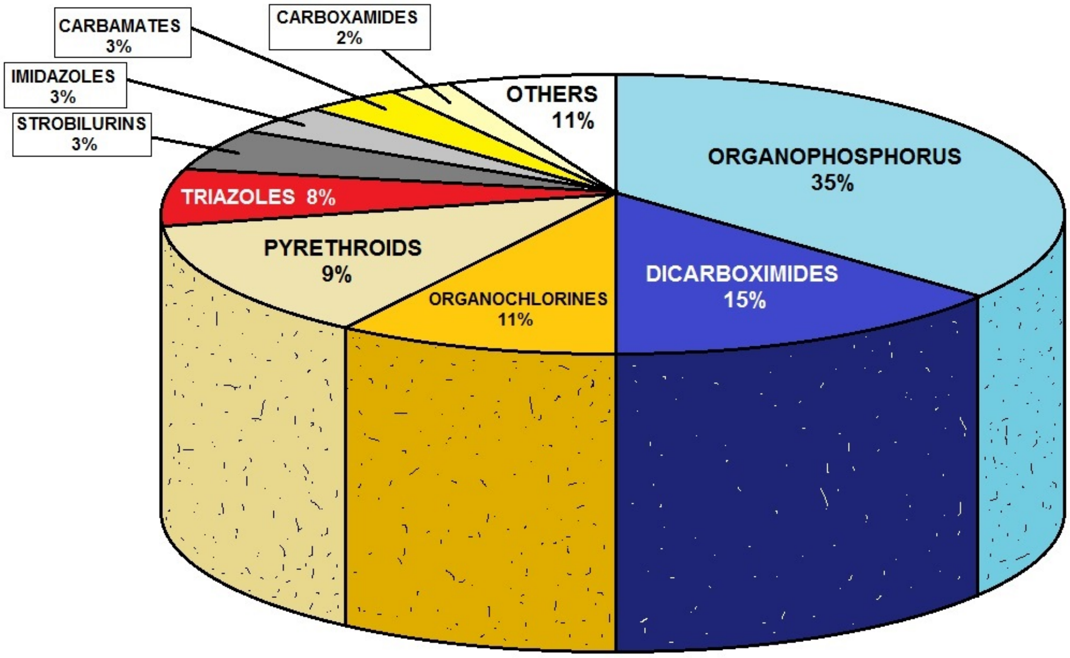
Three main types of bait products are available:
- Ingested toxicants or stomach poisons.
- Biotermiticides or microbes.
- Insect growth regulators (IGRs).

Each type has unique features and is used differently in termite control programs. Ingested toxicants have the quickest effect, though dose dependency and learned avoidance may limit this type of product to termite reduction in localized areas.

Biotermiticides, derived from fungi, bacteria, or nematodes, are injected into active gallery sites. They then develop on the infected foraging termites and spread among the colony. Suitable temperature and moisture, early detection, and avoidance are factors that determine this treatment's success. It may provide localized area control or, with optimum conditions, may suppress a colony.

Among the insect growth regulators are juvenile hormone analogs (JHA), juvenile hormone mimics (JHM), and chitin synthesis inhibitors (CSI). These products disrupt the termites by causing a specific response or behavior within the colony or by blocking the molting process.

Remember that all insects, including termites, have an exoskeleton made primarily of chitin. To grow, they must periodically shed their chitinous exoskeletons and form new ones. This process is called molting. A chitin synthesis inhibitor slowly builds up in the termite and, the next time a molt occurs, prevents proper formation of the cuticle. IGRs are the slowest acting of the bait types.



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PERCENTAGE OF PESTICIDE BY CHEMICAL CLASSIFICATION

Commercial Baiting Products

Sentricon™ System
Sentricon™ System, developed by Dow AgroSciences for professional use, combines monitoring with the use of permanent stations. Stations are installed in areas where termites exist and around the perimeter of a structure and in the yard. Each station contains a wood stake and must be periodically monitored for termite activity.

After termites attack, the wood is removed and replaced with a bait tube. Termites from the wood must be transferred to the bait tube, which is left in the station until termite activity ceases. Then the bait tubes are replaced with new wood stakes and monitoring for new infestations resumes.

Thus, the Sentricon™ System protects property through an integrated program of monitoring, baiting when termites are present and resuming monitoring when termites are no longer present. The active ingredient in the Sentricon™ System is hexaflumuron, a chitin synthesis inhibitor. The philosophy behind the Sentricon™ System is that foraging pseudergates will feed on the bait, return to the colony and pass the bait to other colony members through trophallaxis. Dow AgroSciences claims that with the Sentricon™ System, colony elimination is possible.

FirstLine™ Termite Bait Stations
FMC Corporation manufactures bait stations for suppression of subterranean termite colonies. The FirstLine™ aboveground termite bait station is applied directly to active termite infestations. It is placed above ground, inside or outside, at the leading edge of active termite mud tubes.

Another product, the FirstLine™ GT in-ground bait station, is placed in the ground in areas conducive to termite attack and acts as a first line of defense against termite invasion of a structure. There are two types of these in-ground bait stations. One type has wood stakes for monitoring the presence of termites. The other type has cardboard treated with sulfluramid. Bait stations are placed in areas where termites are present or very close to monitoring stations that have been attacked by termites.

The active ingredient in FirstLine™ termite bait stations is sulfluramid, a slow-acting stomach poison. The philosophy behind the FirstLine™ products is that many termites will feed on the bait and over time will die. Research with these bait stations demonstrates that reduction of the termite population is possible, but not elimination. FMC Corporation also markets Interceptor™, an on-the-wall application. This product is placed over a termite tube. The tube is broken open to allow termites to have access to the bait. The active ingredient is sulfluramid.

Exterra® Termite Interception and Baiting System
Ensystex Incorporated manufactures a termite baiting system called Exterra® Termite Interception and Baiting System. The in-ground stations are designed to permit visual inspection without removing or disturbing the stations. The chitin synthesis inhibitor diflubenzuron (Labyrinth®) is the active ingredient in the bait matrix, a shredded paper towel material.

Subterfuge® Termite Bait
BASF manufactures Subterfuge® termite bait with hydramethylnon as the active ingredient mixed into bait matrix. This baiting system places the active ingredient in the ground at the same time the station is placed in the ground. Hydramethylnon is a member of the amidinohydrazone family of chemistry and is primarily active as a stomach poison. It is also non-repellent to termites. It works on the mitochondria of cells and ultimately shuts down energy production, resulting in death in a manner similar to chlorfenapyr.

BioBlast™
An example of a biotermiticide is BioBlast™, manufactured by EcoScience. BioBlast™ is an EPA registered wettable powder containing live spores of the insect killing fungus Metarhizium anisopliae. This product is injected into the termite galleries. The spores germinate, penetrate the cuticles of termites and kill them. Spores are carried throughout the colony in a manner known as "horizontal transfer." BioBlast™ controls termites in localized areas if conditions are right for the fungus to grow.

More About Bait Technology

Baits
Bait technology uses wood or a cellulose matrix favored by termites that is impregnated with a slow-acting toxic chemical. Termite workers feed upon the bait and transfer it to other colony members by grooming or trophallaxis, eventually reducing or eliminating the entire colony. Termites are not site-specific, but rather, they forage among various food sites, which results in the bait being encountered by many colony members. The toxicant necessarily is slow acting because termites tend to avoid sites where sick and dead termites accumulate.

Typically, in-ground stations are inserted in the soil next to the structure and near known or suspected sites of termite activity. In-ground stations often initially contain untreated wood that serves as a monitoring device. The monitoring wood is replaced with the toxicant once termites have been detected feeding on it. In addition, aboveground stations may be installed inside or on the structure in the vicinity of damaged wood and shelter tubes. Aboveground stations initially contain bait.

It is very important that bait systems are properly installed and diligently serviced. Monthly inspections of a baiting system usually are necessary, except during inclement winter weather. Successful termite baiting necessitates proper monitoring and maintenance of the stations. Baits work much more slowly than soil termiticides, and the homeowner should be aware of the possibility of a lengthy baiting process. Several months or more may elapse before the termites locate stations, then termites must feed on sufficient amounts of the toxicant.

An often-cited advantage of termite baits is that they are "environmentally-friendly" because they use very small quantities of chemical and decrease the potential for environmental contamination. In addition, bait application causes little disruptive noise and disturbance compared to soil treatments. Furthermore, baits can be used in structures with wells or cisterns, sub-slab heating ducts, and other features that may preclude a soil treatment. Baits are often used in sensitive environments.

A number of baits have been marketed to control termites. Bait products that are available for licensed pest management professionals include the Sentricon® Termite Colony Elimination System (hexaflumuron [Recruit® II bait] or noviflumuron [Recruit® III bait]), FirstLine® Termite Defense System (sulfluramid), Exterra® Termite Interception and Baiting System (diflubenzuron [Labyrinth® bait]), Subterfuge® Termite Bait (hydramethylnon), and Outpost® Termite Bait Response (diflubenzuron). Not all of these bait systems are equally effective. It is advisable to review the independent research that has been conducted on a particular bait, as some products have been evaluated much more rigorously than others.

Spectracide Terminate® (sulfluramid) and Termirid® 613 (borate) can be purchased by homeowners. However, Terminate® is not recommended as sole protection against termites, and an active infestation should be treated by a professional. Termirid® can be used to reduce subterranean termite populations. Little or no research has been conducted to verify the effectiveness of these products, particularly when used by homeowners.

When deciding whether or not to use baits, it is important to remember that this is a relatively new technology. Baits are still being evaluated and their long-term success is unproven. However, the concept of controlling termites with baits is promising. You, the termite control professional, must determine which approach, colony elimination or suppression, will succeed in each situation.

Baits may require from a few weeks to several months to control termites, depending on such factors as the product selected, application timing, the time to discovery by the termites, the amount of feeding the colony does, colony size and other control measures used.

Baits fit well in an integrated pest management (IPM) control program, along with eliminating conditions conducive to termite infestation, judicious use of liquid soil products as a spot or limited barrier application and use of wood treatment products. An IPM program will require more frequent visits to the site for monitoring and to provide ongoing service. Applicators are strongly encouraged to familiarize themselves with bait technology and future products.

Drilling in concrete is hard work; there are days you might drill every day, it is best to work as a two-man team if you are doing termite treatments.

Beware of hitting rebar and deep footers. After your first inspection, draw a detailed plan of action and map your treatment methods, this is required by law and good for your records and customers as well. Subs are easy to kill if you do a good treatment. It might take a month but if termites are treated correctly, Subs are walking dead.

Termite Product Applications Sub-Section

Building With a Basement and Crawl Space

Basement: For an interior vertical barrier, drill the floor slab and space holes about one foot apart. Drilling may be required along the foundation walls, along one side of partition walls, along both sides of load-bearing wall, around sewer pipes, floor drains, conduits, and any crack in the basement floor. Using a sub-slab injector, inject the insecticide at the rate of 4 gallons per 10 linear feet. For an insecticide barrier around the exterior of foundation walls, apply an insecticide by rodding and/or trenching. The rod holes should be spaced 1 to 1 1/2 feet apart to provide a continuous chemical barrier. If a trench is necessary, it should not be wider than 6 inches. Inject insecticide using rodding technique at the rate of 4 gallons per 10 linear feet. Cover the trench with untreated soil.

Crawl Spaces

Establish vertical barriers by rodding and/or trenching procedures. A shallow trench should not be wider than 6 inches. Space rod holes about 1 to 1 1/2 feet apart. Apply insecticide at the rate of 4 gallons per 10 linear feet per foot of depth. Do not treat soil in crawl space area with a broadcast insecticide spray.

Hollow Masonry Units of the Foundation Walls

Treat through masonry voids to provide a continuous chemical barrier at the top of the footing. When treatment is necessary, access holes must be drilled through mortar joints below the sill plate, as close as possible to the footing. Apply insecticide at the rate of 2 gallons per 10 linear feet. Plug all holes with mortar or any other special compound.

Bath Traps

Soil may require insecticide treatment if it is exposed beneath and around plumbing/waste pipe entrances through a concrete slab. Remove any wood or other debris and treat the soil by rodding or flooding with an insecticide solution.

Treatment Near Ponds, Wells, Cisterns, and Faulty Foundation Walls, Around Pipes or Utility Lines

Insecticide applications through rodding is discouraged in such situations. The suggested procedure is to make a trench and remove the soil to be treated onto a heavy plastic sheeting or similar material. Treat the excavated soil with insecticide at the rate of 4 gallons per 10 linear feet per foot of depth. Mix the soil with insecticide and replace it in the trench. Cover the treated soil with a thin layer of untreated soil. In the case of wells, ponds, and cisterns, if a rodding technique is necessary, the distance between the treated area and the water source should be 50 feet or more.

Wood Treatment

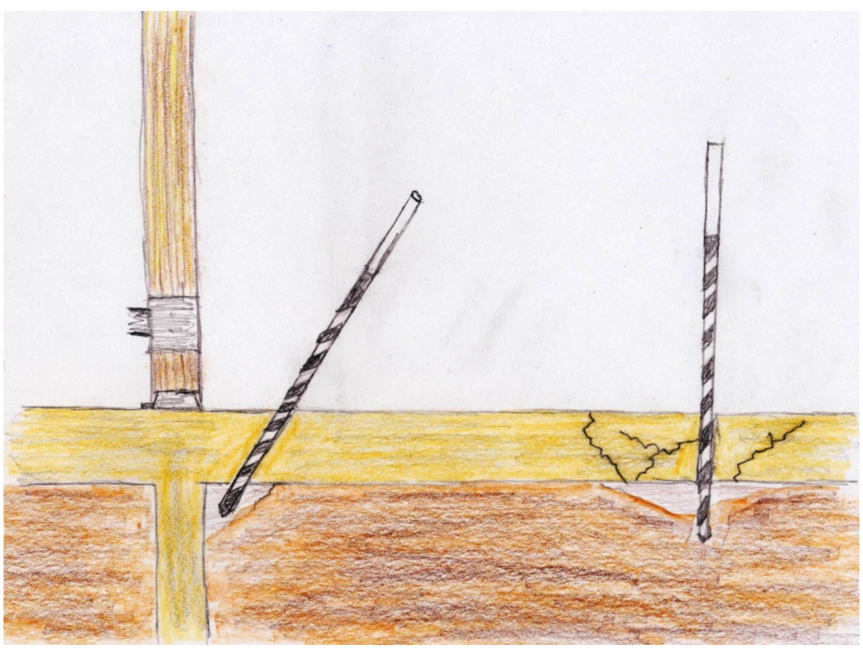
In addition to soil treatment, it may be necessary to treat infested wood with insecticide spray or injection. Applications are made to inaccessible areas by drilling and then injecting the insecticide solution. Broadcast spray must be limited to wood in attics, crawl spaces and unfinished basements or similar unoccupied areas.

Treatment of Secondary Subterranean Termite Colony

Apply insecticide to infested wood and void spaces with a crack and crevice injector.

Carefully measure and mix the product and always use your air gap water protection device. So many applicators risk damaging the public water supply if they do not follow instructions and do not utilize the air gap protection device. Most applicators do not carefully measure the product to the instructions, this a not cost effective and usually the owners or managers are the ones need to properly instruct the chemical usage. I think this chemical costs about 80 cents an ounce and that doesn't seem to be that much but if you are wasting two or three dollars per job, that will cut the profit and may indeed end someone career.

You need to properly identify the pest target, so many applicators treat subs with drywood methods and these methods will not work. Subs live under the slab. Pull the carpet up and drill down. Control of subterranean termites in buildings can be difficult and expensive. Chemical (termiticide) treatment is a proven means of protecting buildings from further damage by subterranean termites. The majority of treatments involves injection of a termiticide around the entire perimeter of the foundation and under the slab (called a full treatment) or may only require a partial treatment of the perimeter if the infestation is very localized. Some termiticides can be sprayed if the infestations are suited to this type of treatment. Therefore, as previously mentioned, it is important that a correct diagnosis and thorough inspection be made before any control measures are implemented.



You must drill pass the concrete slab into order to reach the termites.

Drilling and dusting the wall voids will help control subs. Always follow the State rule and the manufacturer's label instructions. Some of my suggestions may not be allowed with certain chemicals and in certain States with California being the strictest. There are several products that I can think of that will destroy subs but few manufacturers will list it on the label. When in doubt, follow the label. This type of treatment will also kill bed bugs and cockroaches. Below, is an example of trenching and drenching or some will say "rodding". This professional is wearing proper respiratory protection but needs gloves while pumping 4 gallons of chemical for every ten feet of trench to kill subs.

Termite Prevention Procedures Sub-Section

Preventive practices are a critical aspect of termite control management. Prevention of subterranean termite infestation of wooden structures centers upon disrupting their ability to locate moisture, food (wood), and shelter. Avoid moisture accumulation near the foundation, which provides water needed for termite survival. Divert water away from the foundation with properly functioning downspouts, gutters, and splash blocks. Soil needs to be graded or sloped away from the foundation in order for surface water to drain away from the building.

Cellulose
Cellulose (wood, mulch, paper, etc.) that is in contact with soil provides termites with ready and unobservable access to food. It is very important to eliminate any contact between the wooden parts of the house foundation and the soil. Maintain at least 6 inches between the soil and porch steps, lattice work, door or window frames, etc. Never stack or store firewood, lumber, newspapers, or other wood products against the foundation or within the crawl space. Prevent trellises, vines, etc. from touching the house. Before and during construction, never bury wood scraps or waste lumber in the backfill, especially near the building. Be sure to remove wooden or cellotex form boards, grade stakes, etc. used during construction. Remove old tree stumps and roots around and beneath the building. Avoid or minimize use of wood mulch next to the foundation.

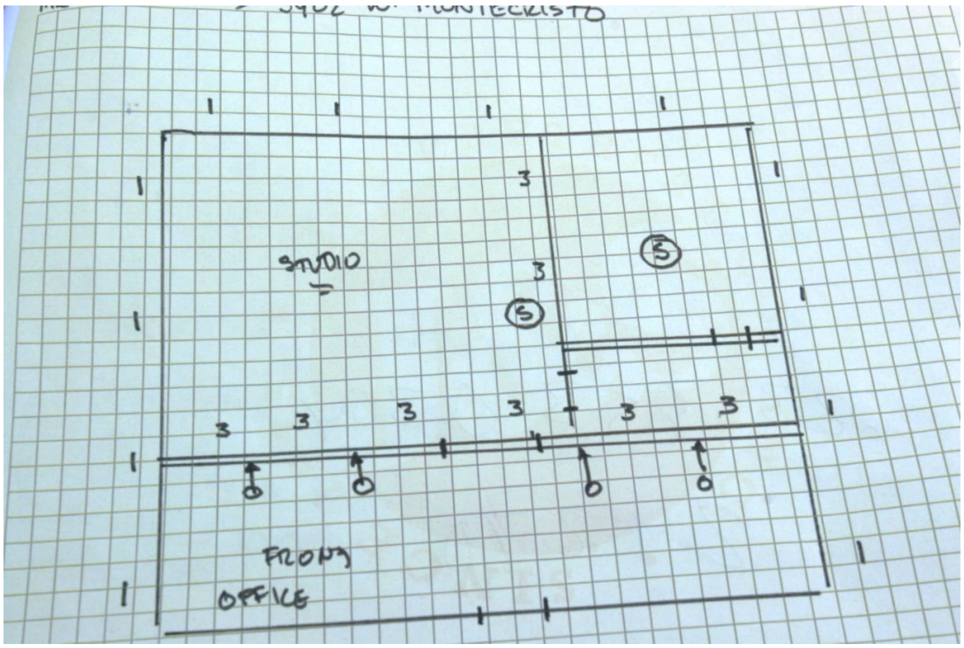
Soil Barrier Termiticides
Conventional soil treatments rely on creating a chemical barrier in the soil that is toxic to termites when they come into contact with it. Many also have repellent characteristics which causes the termites to avoid treated soil. To achieve termite control for long periods of time, such termiticides must be applied as a continuous barrier in the soil next to and under the foundation. If there are untreated gaps in the soil, termites may circumvent the chemical treatment. Hence, such treatments during preconstruction can provide for more uniform coverage. Once a home is constructed, the chemical has to be injected through drill holes and trenching around the foundation, which can result in less accurate coverage. Effective termite control usually requires specialized equipment and often 150 or more gallons of prepared termiticide solution per house, depending on size, basement, etc.

Termiticides that act by creating a chemical barrier in the soil include bifenthrin (Talstar®), cypermethrin (Demon®, Prevail®), and permethrin (Dragnet®, Prelude®). Chlorpyrifos (Dursban®) can be used only during preconstruction and only until December 31, 2005.

In reference to "**spot treatments only**" (using chemical barrier termiticides only in areas of the house where termites are seen), most pest management firms will refuse such treatments or will not guarantee them. The reason is that termites have a very high probability of finding other untreated points of entry into the structure. Localized spot treatments are considered risky except in re-treatment situations.

Treated-Zone - Termiticides
The most recent termiticides to be marketed are non-repellent to termites, but show delayed toxicity as termites forage through treated soil, which they do not avoid. As termites penetrate the "treated zone," they contact the active ingredient, which causes delayed mortality and also possibly allows the termites to be overcome by lethal microbes.

Furthermore, the toxicant is thought to be passed to nest mates through grooming activities and social food exchange (trophallaxis). Control usually is achieved within 3 months. As with soil barrier termiticides, specialized application equipment and large volumes of chemical solution are needed. Non-repellent termiticides include fipronil (Termidor®), imidacloprid (Premise®), and chlorfenapyr (Phantom®).



Types of Pesticide Spectrums

Broad-Spectrum
A pesticide that is effective against many pest. An example of a broad-spectrum pesticide is methyl bromide, which is designed to control pests ranging from small insects and pathogens to larger weeds and rodents. The pesticide can be injected into the ground to kill organisms in the soil that might harm the plant while it is growing. It can also be pumped into warehouses or barns to kill pests that could harm the plant during storage or transport for sale.

Narrow-Spectrum AKA Target-Spectrum
Developed to kill specific organism types. An example of a narrow-spectrum pesticide is chitin inhibitors, which are chemicals that interact with chitin, a component of the exoskeleton of insects. This pesticide inhibits the development of chitin and will eventually result in the death of the insect. The chitin inhibiting pesticide will only harm insects that have chitin in their exoskeletons and will not affect other insects.

There are several methods of patching the drill holes. Many applicators prefer the caulking type of patch but others like to mix cement and do it the old-school way. Either way, termite treatment is a hard way to make money. It is good money but long and hard work. The good news, there are more termites and they seem to be thriving.

Every day I am able to find subs and drywoods attacking both homes and businesses. I think it is best to purchase two of the best hammer drill and bits you can afford. It is no fun to run in to a well-poured slab or rebar. I prefer the 4-inch thick slabs but they are rare.

Required Inspection
By state law, the minimum requirement for termite inspections includes visual searches of accessible areas. However, detection of difficult-to-find infestations may require removing walls, paneling, and stucco, as well as using ladders and scaffolds.

Read the pesticide product label - The label tells you exactly how the product is to be used and provides information on potential risks. If the label does not include directions to control termites and protect the structure, then the product is not intended to protect the structure against termites and should not be applied. If you wish to see a copy of the product label, ask the company representative for a copy. Always be prepared to provide a copy of the label information to the business or homeowner. We cannot stress the dangers of pesticide application and the high death and injury rate due to applicators not following label instructions.

Be aware of the how soon you can return to the treated residence - The time required before the residence can be re-occupied will vary by product and will be indicated on product labels. Make sure to inform the business or homeowner when it is safe to reenter the building.

Whatever termite treatment, always write down everything you did. Carefully write the chemical amounts and the areas you did not treat. Both the State and the customers like to see this professionalism. Of course, paperwork takes a large percentage of time, but it is an insurance policy and covers your rear end if something comes back.

Alternative Termite Controls

Treated Wood
Borates (disodium octaborate tetrahydrate [Tim-bor®, Bora-Care®, Jecta®], Impel®) and pressure-treatments (creosote, chromated copper arsenate [CCA]) protect wood against termites and wood-decay fungi. However, even creosote-treated railroad ties and telephone poles, and CCA-treated wood, over time, can be subject to termite attack. Termites can build mud tubes over treated surfaces. Furthermore, they can gain entry through cut and cracked ends or areas where the chemical has not sufficiently penetrated.

Wood treatments are primarily used to supplement other termite control measures, because termites are able to attack untreated wood in other areas of the structure. It is advisable to use pressure-treated wood in situations where wood is in direct contact with soil or is exposed to rainfall. Borates are fairly soluble in water, so borate-treated wood should be protected from constant rewetting.

Borates may be applied to wood by homeowners. As of 1 January 2004, CCA-treated wood is no longer available for use in most residential settings because of concerns regarding its arsenic content.

Physical Barriers
Physical barriers are particularly appropriate during the preconstruction phase to provide protection of the structure from subterranean termites. One such physical barrier is stainless-steel wire mesh (TermiMesh®) that is fitted around pipes, posts, or foundations. The newest physical barrier, Impasse® Termite System, contains a liquid termiticide (lambda-cyhalothrin) locked between two layers of heavy plastic that is installed before the concrete slab is poured. It is supplemented with Impasse® Termite Blocker, which uses special fittings around plumbing and electrical pipes and conduits.

Biological Control Agents
Certain species of parasitic round worms (nematodes) will infest and kill termites and other soil insects. They have been promoted and marketed by a few companies. Although effective in the laboratory, control is often quite variable under field conditions. Limited success with nematode treatments may be attributed to the ability of termites to recognize and wall-off infected individuals, hence limiting the spread of nematodes throughout the colony.

Furthermore, soil moisture and soil type appear to limit the nematode's ability to move in the soil and locate termites. A fungus Metarhizium anisopliae (Bio-Blast®) is a biological termiticide that requires special application and handling techniques. It is labeled for aboveground application to termite infestations in structures, but it is not labeled for application to the soil.

Spray effectiveness is enhanced when applied to many foraging termites because infected termites can pass the fungus to nest mates. However, it is difficult to infect a large enough number of termites for the infection to spread throughout the colony. Furthermore, it provides no long-lasting residual activity, and the fungal spores die with the dead termites.

Insufficient research has been conducted to indicate whether this is an effective method for controlling termites.

Elimination of Dursban Pesticide for Nearly all Household Uses

To protect children and public health, the EPA and the manufacturer of the pesticide Dursban have agreed to eliminate its use for nearly all household purposes and to move to significantly reduce residues of it on several foods regularly eaten by children.

Dursban, also known as chlorpyrifos, is the most widely used household pesticide produced in the U.S. It is an ingredient used for a broad range of lawn and home insecticide products, for agricultural purposes, and for termite treatment.

Under the agreement, production will cease and there will be a phase-out of all home, lawn and garden uses, as well as the vast termite control uses.

"Chlorpyrifos is part of a class of older, riskier pesticides, some going back 50 years. Exposure to these kinds of pesticides can cause neurological effects. Now that we have completed the most extensive evaluation ever conducted on the potential health hazards from a pesticide, it is clear that the time has come to take action to protect our children from exposure to this chemical," said EPA Administrator Carol M. Browner.

The agreement mandates that all uses will be phased out this year in areas where children could be exposed, including schools, daycare centers, parks, recreation areas, hospitals, nursing homes, stores and malls. In addition, the agreement calls for canceling or significantly lowering allowable residues for several foods regularly eaten by children, such as tomatoes, apples and grapes. These actions will be taken by the beginning of the next growing season.

Wood Preservative Sub-Section

Many of our students are not pesticide applicators but are in some type of wood preservation or similar work, like building wine vats or wood working. Because States may require these professionals to possess a pesticide license, we will examine wood preservatives in relationship to wood destroyers and wood preservation methods. Wood preservatives must meet two broad criteria: (1) They must provide the desired wood protection in the intended end use, and (2) they must do so without presenting unreasonable risks to people or the environment. Because wood preservatives are considered to be a type of pesticide, the U.S. Environmental Protection Agency (EPA) is responsible for their regulation. Federal law requires that before selling or distributing a preservative in the United States, a company must obtain registration from EPA. Before registering a new pesticide or new use for a registered preservative, EPA must first ensure that the preservative can be used with a reasonable certainty of no harm to human health and without posing unreasonable risks to the environment. To make such determinations, EPA requires more than 100 different scientific studies and tests from applicants. This chapter discusses only wood preservatives registered by the EPA.

Some preservatives are classified as "restricted use" by the EPA and these can be used only in certain applications and can be applied only by certified pesticide applicators. Restricted use refers to the chemical preservative and not to the treated wood product. The general consumer may buy and use wood products treated with restricted-use pesticides; EPA does not consider treated wood a toxic substance nor is it regulated as a pesticide. Although treated wood is not regulated as pesticide, there are limitations on how some types of treated wood should be used. Consumer Information Sheets (EPA-approved) are available from retailers of creosote-, pentachlorophenol-, and inorganic-arsenical-treated wood products.

The sheets provide information about the preservative and the use and disposal of treated-wood products (see Synopsis of EPA-Approved Consumer Information Sheets for Wood Treated with CCA, ACZA, Creosote, or Pentachlorophenol). The commercial wood treater is bound by the EPA regulation and can treat wood only for an end use that is allowed for that preservative.

Some preservatives that are not classified as restricted by EPA are available to the general consumer for non-pressure treatments. It is the responsibility of the end user to apply these preservatives in a manner that is consistent with the EPA-approved labeling. Registration of preservatives is under constant review by the EPA, and a responsible State or Federal agency should be consulted as to the current status of any preservative.

Penta or Pentachlorophenol

Penta or Pentachlorophenol (PCP) is an organochlorine compound used as a pesticide and a disinfectant. First produced in the 1930s, it is marketed under many trade names. It can be found in two forms: PCP itself or as the sodium salt of PCP, which dissolves easily in water.

In the past, PCP has been used as a herbicide, insecticide, fungicide, algaecide, disinfectant and as an ingredient in antifouling paint. Some applications were in agricultural seeds (for nonfood uses), leather, masonry, wood preservation, cooling tower water, rope and paper mill system. Its use has been significantly declined due to the high toxicity of PCP and its slow biodegradation.

There are two general methods for preserving wood. The pressure process method involves placing wood in a pressure-treating vessel where it is immersed in PCP and then subjected to applied pressure. In the non-pressure process method, PCP is applied by spraying, brushing, dipping, and soaking. Utility companies save millions of dollars in replacement poles, because the life of these poles increases from approximately 7 years for an untreated pole to about 35 years for a preservative-treated pole.

PCP has been detected in surface waters and sediments, rainwater, drinking water, aquatic organisms, soil, and food, as well as in human milk, adipose tissue, and urine. As PCP is generally used for its properties as a biocidal agent, there is considerable concern about adverse ecosystem effects in areas of PCP contamination.

Releases to the environment are decreasing as a result of declining consumption and changing use methods. However, PCP is still released to surface waters from the atmosphere by wet deposition, from soil by run off and leaching, and from manufacturing and processing facilities.

PCP is released directly into the atmosphere via volatilization from treated wood products and during production.

Finally, releases to the soil can be by leaching from treated wood products, atmospheric deposition in precipitation (such as rain and snow), spills at industrial facilities and at hazardous waste sites.

Since the early 1980s, the purchase and use of PCP in the U.S has not been available to the general public. Nowadays most of the PCP used in the U.S is restricted to the treatment of utility poles and railroad ties. In the United States, any drinking water supply with a PCP concentration exceeding the MCL, 1 ppb, must be notified by the water supplier to the public. Disposal of PCP and PCP contaminated substances are regulated under RCRA as a F-listed hazardous waste.

What are the key points for parents and consumers concerned about exposure from structures made of CCA-treated wood?

- ✓ If you are concerned about potential exposure to arsenic, sealants, when applied at least once a year, have been shown to reduce dislodgeable arsenic from the wood.
- ✓ Oil or water-based, penetrating sealants or stains are preferred.
- ✓ As always, parents and other caretakers should follow these precautions for children who play on or near decks. Always wash hands thoroughly after contact with treated wood, especially prior to eating and drinking, and ensure that food does not come into direct contact with any treated wood.
- ✓ At this time, we do not believe there is any reason to remove or replace CCA treated structures, including decks and playground equipment, but all the things and laws change like on an everyday basis.
- ✓ Consumers should follow manufacturer recommendations when handling the wood, including the same precautions that workers should take: wear gloves when handling wood, wear goggles and dust masks when sawing and sanding, always wash hands before eating, and never burn CCA treated wood.

Precautions and Personal Protection Measures

Wood treated with modern preservatives is generally safe to handle given appropriate handling precautions and personal protection measures. However, treated wood may present certain hazards in some circumstances such as during combustion or where loose wood dust particles or other fine toxic residues are generated or where treated wood comes into direct contact with food and agriculture.

Preservatives containing copper in the form of very small particles have recently been introduced to the market, usually with "micronized" or "micro" trade names and designations such as MCQ or MCA. While the manufacturers represent that these products are safe and EPA has registered these products, some groups have expressed concerns regarding exposure to engineered sub-micron and nano-sized copper particles. These concerns have led to a debate among advocacy groups and governments on whether special regulation of nanotechnology is warranted.

Material safety data sheets and safe handling guidelines are required by law to be provided by suppliers of wood preservative chemicals and treated wood products. This information should be obtained and reviewed before handling and using wood preservative chemicals and treated wood products

Re-Registration Eligibility Decisions (RED)
EPA has completed its re-registration eligibility decisions (RED) for the heavy duty wood preservatives chromated arsenicals, pentachlorophenol, and creosote. In general, EPA has determined that the compounds contribute benefits to society and are eligible for reregistration provided the mitigation measures and associated label changes identified in the REDs are implemented and required data are submitted. In its risk assessments, the Agency identified risks of concern associated with occupational exposure (i.e., treatment plant workers) to all three preservatives and ecological exposure to pentachlorophenol and creosote.

Chromated Copper Arsenate (CCA)

Chromated copper arsenate (CCA) is a chemical wood preservative containing chromium, copper and arsenic. CCA is used in pressure treated wood to protect wood from rotting due to insects and microbial agents. EPA has classified CCA as a restricted use product, for use only by certified pesticide applicators.

CCA has been used to pressure treat lumber since the 1940s. Since the 1970s, the majority of the wood used in outdoor residential settings has been CCA-treated wood. Pressure treated wood containing CCA is no longer being produced for use in most residential settings, including decks and playsets.

The Agency has completed its reregistration eligibility decision (RED) and will continue to work with stakeholders to implement its decision. Pesticide manufacturers to voluntarily phased out certain CCA use for wood products around the home and in children's play areas. Effective December 31, 2003, no wood treater or manufacturer may treat wood with CCA for residential uses, with certain exceptions.

Timeline for Reregistration/Risk Assessment
September 25, 2008 – Chromated Arsenicals Reregistration Eligibility Decision (RED) signed.
November 19, 2008 – Announce availability of RED in Federal Register.
March 31, 2009 – Updated product labels reflecting mitigation to be submitted to EPA.
December 31, 2013 – All treatment plants to be upgraded to reflect measures outlined in RED.
Synopsis of EPA-approved consumer information sheets for wood treated with CCA, ACZA, creosote, or pentachlorophenol

NOTE: This is only a synopsis of information contained in consumer information sheets. For complete consumer information sheets, contact your treated wood supplier or the website of the Environmental Protection Agency.

Handling Precautions

- Avoid frequent or prolonged inhalation of sawdust from treated wood. When sawing, sanding, and machining treated wood, wear a dust mask. Whenever possible, these operations should be performed outdoors to avoid indoor accumulations of airborne sawdust from treated wood. When power-sawing and machining, wear goggles to protect eyes from flying particles. Wear gloves when working with the wood. After working with the wood, and before eating, drinking, toileting, and use of tobacco products, wash exposed areas thoroughly. Avoid frequent or prolonged skin contact with creosote- or pentachlorophenol-treated wood. When handling creosote- or pentachlorophenol-treated wood, wear long-sleeved shirts and long pants and use gloves impervious to the chemicals (for example, gloves that are vinyl coated). Because preservatives or sawdust may accumulate on clothes, they should be laundered before reuse. Wash work clothes separately from other household clothing.
- Treated wood should not be burned in open fires or in stoves, fireplaces, or residential boilers, because toxic chemicals may be produced as part of the smoke and ashes. Treated wood from commercial or industrial use (such as construction sites) may be burned only in commercial or industrial incinerators or boilers in accordance with state and Federal regulations. CCA-treated wood can be disposed of with regular municipal trash (municipal solid waste, not yard waste) in many areas. However, state or local laws may be stricter than federal requirements. For more information, please contact the waste management agency for your state.

- Use Site Precautions.
- All sawdust and construction debris should be cleaned up and disposed of after construction. Do not use treated wood under circumstances where the preservative may become a component of food or animal feed. Examples of such sites would be use of mulch from recycled arsenic-treated wood, cutting boards, counter tops, animal bedding, and structures or containers for storing animal feed or human food. Only treated wood that is visibly clean and free of surface residue should be used for patios, decks, and walkways. Do not use treated wood for construction of those portions of beehives which may come into contact with honey. Treated wood should not be used where it may come into direct or indirect contact with drinking water, except for uses involving incidental contact such as docks and bridges.

- Logs treated with pentachlorophenol should not be used for log homes. Wood treated with creosote or pentachlorophenol should not be used where it will be in frequent or prolonged contact with bare skin (for example, chairs and other outdoor furniture), unless an effective sealer has been applied. Creosote- and pentachlorophenol-treated wood should not be used in residential, industrial, or commercial interiors except for laminated beams or building components that are in ground contact and are subject to decay or insect infestation and where two coats of an appropriate sealer are applied. Do not use creosote- or pentachlorophenol-treated wood for farrowing or brooding facilities.
- Wood treated with pentachlorophenol or creosote should not be used in the interiors of farm buildings where there may be direct contact with domestic animals or livestock that may crib (bite) or lick the wood. In interiors of farm buildings where domestic animals or livestock are unlikely to crib (bite) or lick the wood, creosote- or pentachlorophenol-treated wood may be used for building components that are in ground contact and are subject to decay or insect infestation and where two coats of an appropriate sealer are applied. Sealers may be applied at the installation site. Urethane, shellac, latex epoxy enamel, and varnish are acceptable sealers for pentachlorophenol-treated wood. Coal-tar pitch and coal-tar pitch emulsion are effective sealers for creosote-treated wood-block flooring. Urethane, epoxy, and shellac are acceptable sealers for all creosote-treated wood.

This publication contains pesticide recommendations that are subject to change at any time. These recommendations are provided only as a guide. It is always the pesticide applicator's responsibility, by law, to read and follow all current label directions for the specific pesticide being used. Due to constantly changing labels and product registration, some of the recommendations given in this writing may no longer be legal by the time you read them. If any information in these recommendations disagrees with the label, the recommendation must be disregarded. No endorsement is intended for products mentioned, nor is criticism meant for products not mentioned. The author and Technical Learning College (TLC) assume no liability resulting from the use of these recommendations.

Wood Preservative Chemical Classes

Before a wood preservative can be approved for pressure treatment of structural members, it must be evaluated to ensure that it provides the necessary durability and that it does not greatly reduce the strength properties of the wood. The EPA typically does not evaluate how well a wood preservative protects the wood. Traditionally this evaluation has been conducted through the standardization process of the AWPA. The AWPA Book of Standards lists a series of laboratory and field exposure tests that must be conducted when evaluating new wood preservatives. The durability of test products are compared with those of established durable products and nondurable controls. The results of those tests are then presented to the appropriate AWPA subcommittees for review. AWPA subcommittees are composed of representatives from industry, academia, and government agencies who have familiarity with conducting and interpreting durability evaluations. Preservative standardization by AWPA is a two-step process. If the performance of a new preservative is considered appropriate, it is first listed as a potential preservative. Secondary committee action is needed to have the new preservative listed for specific commodities and to set the required treatment level.

Two General Classes
Wood preservatives have traditionally been divided into two general classes: (1) Oil-type or oil-borne preservatives, such as creosote and petroleum solutions of pentachlorophenol, and (2) waterborne preservatives that are applied as water solutions or with water as the carrier. Many different chemicals are in each of these classes, and each has different effectiveness in various exposure conditions. Some preservatives can be formulated so that they can be delivered with either water or oil-type carriers. In this chapter, both oil-borne and waterborne preservative chemicals are described as to their potential end uses.

Chemical preservatives can be classified into three broad categories: water-borne preservatives, oil-borne preservatives, and light organic solvent preservatives (LOSPs). These are discussed in more detail below.

Timber or lumber that is treated with a preservative generally have it applied through vacuum and/or pressure treatment. The preservatives used to pressure-treat timber are classified as pesticides. Treating timber provides long-term resistance to organisms that cause deterioration. If it is applied correctly, it extends the productive life of timber by five to ten times. If left untreated, wood that is exposed to moisture or soil for sustained periods of time will become weakened by various types of fungi, bacteria or insects.

Waterborne Preservatives
Waterborne preservatives are often used when cleanliness and paintability of the treated wood are required. Formulations intended for use outdoors have shown high resistance to leaching and very good performance in service.

Waterborne preservatives are included in specifications for items such as lumber, timber, posts, building foundations, poles, and piling. Because water is added to the wood in the treatment process, some drying and shrinkage will occur after installation unless the wood is kiln-dried after treatment.

Copper is the primary biocide in many wood preservative formulations used in ground contact because of its excellent fungicidal properties and low mammalian toxicity. Because some types of fungi are copper tolerant, preservative formulations often include a co-biocide to provide further protection.

Inorganic arsenicals are a restricted-use pesticide. For use and handling precautions of pressure-treated wood containing inorganic arsenicals, refer to the EPA-approved Consumer Information Sheets.

Water is the most common solvent carrier in preservative formulations due to its availability and low cost. Water-borne systems do however have the drawback that they swell timber, leading to increased twisting, splitting and checking than alternatives.

Acid Copper Chromate (ACC)
Acid copper chromate (ACC) contains 31.8% copper oxide and 68.2% chromium trioxide (AWPA P5). The solid, paste, liquid concentrate, or treating solution can be made of copper sulfate, potassium dichromate, or sodium dichromate. Tests on stakes and posts exposed to decay and termite attack indicate that wood well impregnated with ACC generally provides acceptable service. However, some specimens placed in ground contact have shown vulnerability to attack by copper-tolerant fungi. ACC has often been used for treatment of wood in cooling towers. Its current uses are restricted to applications similar to those of chromated copper arsenate (CCA).

ACC and CCA must be used at low treating temperatures (38 to 66 °C (100 to 150 °F)) because they are unstable at higher temperatures. This restriction may involve some difficulty when higher temperatures are needed to obtain good treating results in woods such as Douglas-fir. This publication contains pesticide recommendations that are subject to change at any time. These recommendations are provided only as a guide. It is always the pesticide applicator's responsibility, by law, to read and follow all current label directions for the specific pesticide being used. Due to constantly changing labels and product registration, some of the recommendations given in this writing may no longer be legal by the time you read them. If any information in these recommendations disagrees with the label, the recommendation must be disregarded. No endorsement is intended for products mentioned, nor is criticism meant for products not mentioned. The author and Technical Learning College (TLC) assume no liability resulting from the use of these recommendations.

Ammoniacal Copper Zinc Arsenate (ACZA)
Ammoniacal copper zinc arsenate (ACZA) is commonly used on the West Coast of North America for the treatment of Douglas-fir. The penetration of Douglas-fir heartwood is improved with ACZA because of the chemical composition and stability of treating at elevated temperatures. Wood treated with ACZA performs and has characteristics similar to those of wood treated with CCA.

ACZA should contain approximately 50% copper oxide, 25% zinc oxide, and 25% arsenic pentoxide dissolved in a solution of ammonia in water (AWPA P5). The weight of ammonia is at least 1.38 times the weight of copper oxide. To aid in solution, ammonium bicarbonate is added (at least equal to 0.92 times the weight of copper oxide). ACZA replaced an earlier formulation, ammoniacal copper arsenate (ACA) that was used for many years in the United States and Canada.

Chromated Copper Arsenate (CCA)
(Most of this information will seem to repeat throughout this manual that is because the widespread use of this chemical.) Chromated copper arsenate or CCA, is a chemical preservative that protects wood from rotting due to insects and microbial agents. CCA contains arsenic, chromium and copper. CCA has been used to pressure treat lumber used for decks, playgrounds (playsets) and other outdoor uses since the 1930's. Since the 1970's, the majority of the wood used in residential settings was CCA-treated wood.

CCA is a registered chemical pesticide that is subject to U.S. Environmental Protection Agency's (EPA's) regulation under the Federal Insecticide, Fungicide, and Rodenticide Act (FIFRA). The playground equipment made with wood treated with CCA is the jurisdictional responsibility of the CPSC and would be subject to the rules of the CPSC's Federal Hazardous Substances Act if found to be a hazardous substance.

Chromated copper arsenate (CCA) is a wood preservative used for timber treatment since the mid-1930s. It is a mix of copper, chromium, and arsenic formulated as oxides or salts. It preserves the wood from decay fungi, wood attacking insects, including termites, and marine borers. It also improves the weather-resistance of treated timber and may assist paint adherence in the long term.

Tanalith" "SupaTimber" and "Celcure"
CCA is known by many trade names, including the worldwide brands "Tanalith" "SupaTimber" and "Celcure". The chromium acts as a chemical fixing agent and has little or no preserving properties; it helps the other chemicals to fix in the timber, binding them through chemical complexes to the wood's cellulose and lignin. The copper acts primarily to protect the wood against decay fungi and bacteria, while the arsenic is the main insecticidal component of CCA. CCA is widely used around the world as a heavy duty preservative, often as an alternative to creosote, and pentachlorophenol. Other water-borne preservatives like CCA include alkaline copper quaternary compounds (ACQ), copper azole (CuAz), ammoniacal copper zinc arsenate (ACZA), copper citrate, and copper HDO (CuHDO)

Recognized for the greenish tint it imparts to timber, CCA is a preservative that has been extremely common for many decades. Over time small amounts of the CCA chemicals, mainly the arsenic, may leach out of the treated timber. This is particularly the case in acidic environments. The chemicals may leach from the wood into surrounding soil, resulting in concentrations higher than naturally occurring background levels. A study found that 12–13 percent of the CCA leached from treated wood buried in compost during a 12-month period.

On the other hand, there have been many other studies in less aggressive soil types that show leaching to be as low as 0.5 ppm (red pine poles in service,) or up to 14 ppm (treated pine in garden beds). Soil contamination due to the presence of CCA-treated wood after 45 years is minimal. Should any chemicals leach from the wood they are likely to bind to soil particles, especially in soils with clay or soils that are more alkaline than neutral.

A number of countries have reviewed CCA during recent years and have looked at limiting the public exposure to CCA-treated timber by restricting its application in residential situations. These reviews have resulted from increasing public pressures and perceptions that arsenic-containing timber poses a health hazard. In response to these pressures the preservation industry in the USA and Canada volunteered not to use CCA for the treatment of residential timber, and on 1 January 2004 the United States Environmental Protection Agency (EPA) began restricting the use of CCA for such purposes.

Exceptions were allowed, including the treatment of shakes and shingles, permanent wood foundations, and certain commercial applications. It should be emphasized however that the regulatory agencies advised that CCA-treated timber products already in use pose no significant threat to health. Indeed, CCA will continue to be used in North America in a wide variety of commercial and industrial applications such as poles, piling, retaining structures and many others.

CCA timber is still in widespread use in many countries and remains an economical option for conferring durability to perishable timbers such as plantation grown pine. Although widespread restrictions followed the publication of studies which showed low-level leaching from in-situ timbers (such as children's playground equipment) into surrounding soil, a more serious risk is presented if CCA-treated timber is burnt in confined spaces such as a domestic fire or barbecue. Scrap CCA construction timber continues to be widely burnt through ignorance, in both commercial and domestic fires.

Notwithstanding this, disposal by burning i.e. in approved incinerators is an acceptable option. It is particularly attractive if there is some energy captured in the process. In addition, CCA treated timber wastes can also be effectively incinerated using high temperatures, i.e. 800°-1100°C.

Disposal of large quantities of CCA-treated wastes or spent timber at the end of its lifecycle has been traditionally through controlled landfill sites. Such sites are lined to make them impervious in order to prevent losses to the water table and they are covered to prevent rainfall washing out any contained potential toxicants. These controlled sites handle a range of waste materials potentially more noxious than that posed by CCA-treated timber, e.g. paint-stuffs, car batteries, etc. Today, landfill sites are becoming scarcer and disposal of waste materials is becoming economically unattractive. The wood preservation and timber industries are therefore researching better ways of dealing with waste treated timber, including CCA-treated material.

In CCA treatment, copper is the primary fungicide, arsenic is a secondary fungicide and an insecticide, and chromium is a fixative which also provides ultraviolet (UV) light resistance. Recognized for the greenish tint it imparts to timber, CCA is a preservative that was extremely common for many decades.

Once decay has started in a piece of wood, the rate and extent of deterioration depend on the duration of favorable conditions for fungal growth. Decay will stop when the temperature of the wood is either too low or too high or when the moisture content is lower than the fungi’s requirements. Decay can resume when the temperature and moisture content become favorable again. Early decay is more easily noted on freshly exposed surfaces of unseasoned wood than on wood that has been exposed and discolored by the weather.

Pressure Treatment Process Sub-Section

Because many of our students are not termite applicators but are in the wood or agriculture pest industry, we will cover the wood pressure treatment process. In the pressure treatment process, an aqueous solution of CCA is applied using a vacuum and pressure cycle, and the treated wood is then stacked to dry. During the process, the mixture of oxides reacts to form insoluble compounds, helping with leaching problems.

The process can apply varying amounts of preservative at varying levels of pressure to protect the wood against increasing levels of attack. Increasing protection can be applied (in increasing order of attack and treatment) for: exposure to the atmosphere, implantation within soil, or insertion into a marine environment.

In the last decade concerns were raised that the chemicals may leach from the wood into surrounding soil, resulting in concentrations higher than naturally occurring background levels. A study cited in Forest Products Journal found 12–13% of the chromated copper arsenate leached from treated wood buried in compost during a 12-month period. Once these chemicals have leached from the wood, they are likely to bind to soil particles, especially in soils with clay or soils that are more alkaline than neutral. In the United States the powerful US Consumer Product Safety Commission issued a report in 2002 stating that exposure to arsenic from direct human contact with CCA treated wood may be higher than was previously thought. On 1 January 2004, the Environmental Protection Agency (EPA) in a voluntary agreement with industry began restricting the use of CCA in treated timber in residential and commercial construction, with the exception of shakes and shingles, permanent wood foundations, and certain commercial applications. This was in an effort to reduce the use of arsenic and improve environmental safety, although the EPA were careful to point out that they had not concluded that CCA treated wood structures in service posed an unacceptable risk to the community. The EPA did not call for the removal or dismantling of existing CCA treated wood structures.

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Alkaline Copper Quaternary

Alkaline copper quaternary (ACQ) is a preservative made of copper, a fungicide, and a quaternary ammonium compound (quat), an insecticide which also augments the fungicidal treatment is a wood preservative that has come into wide use in the USA, Europe, Japan and Australia following restrictions on CCA. Its use is governed by national and international standards, which determine the volume of preservative uptake required for a specific timber end use.

Since it contains high levels of copper, ACQ-treated timber is five times more corrosive to common steel. It is necessary to use double-galvanized or stainless steel fasteners in ACQ timber.

Use of fasteners meeting or exceeding requirements for ASTM A 153 Class D meet the added requirements for fastener durability. The U.S. began mandating the use of non-arsenic containing wood preservatives for virtually all residential use timber in 2004.

The American Wood Protection Association (AWPA) standards for ACQ require a retention of 0.15 lb/ft^3 (PCF) for above ground use and 0.40 lb/ft^3 for ground contact.

Chemical Specialties, Inc. (CSI, now Viance) received U.S. Environmental Protection Agency's Presidential Green Chemistry Challenge Award in 2002 for commercial introduction of ACQ. Its widespread use has eliminated major quantities of arsenic and chromium previously contained in CCA.

Alkaline Copper Quat (ACQ)
Alkaline copper quat (ACQ) has an actives composition of 67% copper oxide and 33% quaternary ammonium compound (quat). Multiple variations of ACQ have been standardized. ACQ type B (ACQ–B) is an ammoniacal copper formulation, ACQ type D (ACQ–D) is an amine copper formulation, and ACQ type C (ACQ–C) is a combined ammoniacal-amine formulation with a slightly different quat compound. The multiple formulations of ACQ allow some flexibility in achieving compatibility with a specific wood species and application. When ammonia is used as the carrier, ACQ has improved ability to penetrate difficult-to-treat wood species. However, if the wood species is readily treatable, such as Southern Pine sapwood, an amine carrier can be used to provide a more uniform surface appearance. Recently ACQ has been formulated using small particles of copper rather than copper solubilized in ethanolamine. These formulations are discussed in more detail in the Preservatives with ICC–ES Evaluation Reports section. Use of particulate copper formulations of ACQ is currently limited to permeable woods (such as species of pine with a high proportion of sapwood), but efforts continue to adapt the treatment to a broader range of wood species.

Alkaline Copper DCOI (ACD)
Alkaline copper DCOI (ACD) is a recently proposed formulation of alkaline copper ethanolamine that utilizes 4,5-dichloro-2-N-octyl-4-isothiazolin-3-one (DCOI) as co-biocide to provide protection against copper-tolerant fungi. The ratio of alkaline copper to DCOI in the formulation ranges from 20:1 to 25:1. The ACD formulation is listed as a preservative in AWPA standards. It has been proposed for both above-ground and ground-contact applications, but at the time this chapter was finalized it had not yet been standardized for treatment of any commodities.

Copper bis(dimethyldithiocarbamate) (CDDC)
Copper bis(dimethyldithiocarbamate) (CDDC) is a reaction product formed in wood as a result of the dual treatment of two separate treating solutions. The first treating solution contains a maximum of 5% bivalent copper–ethanolamine (2-aminoethanol), and the second treating solution contains a minimum of 2.5% sodium dimethyldithiocarbamate (AWPA P5). Although this preservative is not currently commercially available, CDDC-treated wood products are included in the AWPA Commodity Standards for uses such as residential construction.

Copper Azole
Copper azole preservative (denoted as CA-B and CA-C under American Wood Protection Association/AWPA standards) is a major copper based wood preservative that has come into wide use in Canada, the USA, Europe, Japan and Australia following restrictions on CCA. Its use is governed by national and international standards, which determine the volume of preservative uptake required for a specific timber end use.

Copper azole is similar to ACQ with the difference being that the dissolved copper preservative is augmented by an azole co-biocide instead of the quat biocide used in ACQ. The azole co-biocide yields a copper azole product that is effective at lower retentions than required for equivalent ACQ performance. It is marketed widely under the Wolmanized brand in North America and the Tanalith brand across Europe and other international markets.

The AWPA standard retention for CA-B is 0.10 lb./ft^3 for above ground applications and 0.21 lb./ft^3 for ground contact applications. Type C copper azole, denoted as CA-C, has been introduced under the Wolmanized brand. The AWPA standard retention for CA-C is 0.06 lb./ft^3 for above ground applications and 0.15 lb./ft^3 for ground contact applications.

The copper azole preservative incorporates organic triazoles such as tebuconazole or propiconazole as the co-biocide, which are also used to protect food crops. The general appearance of wood treated with copper azole preservative is similar to CCA with a green coloration.

Copper HDO (CXA)
Copper HDO (CXA) is an amine copper water-based preservative that has been used in Europe and was recently standardized in the United States. The active ingredients are copper oxide, boric acid, and copper–HDO (bis-(N-cyclohexyldiazeniumdioxy copper). The appearance and handling characteristics of wood treated with copper HDO are similar to those of the other amine copper-based treatments. It is also referred to as copper xyligen. Currently, copper HDO is standardized only for applications that are not in direct contact with soil or water.

Copper Naphthenate (Waterborne)
Waterborne copper naphthenate (CuN–W) has an actives composition similar to oil-borne copper naphthenate, but the actives are carried in a solution of ethanolamine and water instead of petroleum solvent. Wood treated with the waterborne formulation has a drier surface and less odor than the oil-borne formulation. The waterborne formulation has been standardized for above-ground and some ground-contact applications.

Other Copper Compounds
These include, copper chromate, copper citrate, acid copper chromate, and ammoniacal copper zinc arsenate (ACZA). The CuHDO treatment is an alternative to CCA, ACQ and CA used in Europe and in approval stages for United States and Canada. ACZA is generally used for marine applications.

Micronized Copper Technology
Particulate (micronized or dispersed) copper preservative technology has recently been introduced in the USA and Europe. In these systems, the copper is ground to micro sized particles and suspended in water rather than being dissolved in a chemical reaction as is the case with other copper products such as ACQ and Copper Azole. There are currently two particulate copper systems in production.

One system uses a quat biocide system (known as MCQ) and is a take-off of ACQ. The other uses an azole biocide (known as MCA or CA-C) and is a take-off of copper azole.

Proponents of the particulate copper systems make the case that the particulate copper system perform as well or better than the dissolved copper systems as a wood preservative.

None of the particulate copper systems have been submitted to the American Wood Protection Association (AWPA) for evaluation, thus the particulate systems should not be used in applications Petition where AWPA standards are required.

However, all of the particulate copper systems have been tested and approved for building code requirements by the International Code Council (ICC). The particulate copper systems provide a lighter color than dissolved copper systems such as ACQ or copper azole.

Proponents of the micronized copper systems claim that the systems are subject to third party inspection under a quality monitor program. However, the monitoring program is not subject to oversight by the American Lumber Standards Committee (ALSC) as is required for the AWPA standard systems.

Two particulate copper systems, one marketed as MicroPro and the other as Wolmanized using CA-C formulation, have achieved Environmentally Preferable Product (EPP) certification. The EPP certification was issued by Scientific Certifications Systems (SCS), and is based on a comparative life-cycle impact assessment with an industry standard.

The copper particle size used in the "micronized" copper products ranges from 1 to 700 nm with an average under 300 nm. Larger particles (such as actual micron-scale particles) of copper do not adequately penetrate the wood cell walls. It is claimed by the proponents of micronized copper products that the copper nano particles which escape the wood will bond readily with organic matter and become biologically inactive.

These micronized preservatives use nano particles of copper oxide, for which there are alleged safety concerns. An environmental group has recently petitioned EPA to revoke the registration of the micronized copper products citing safety issues.

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Borate Preservatives

Boric acid, oxides and salts (borates) are effective wood preservatives and are supplied under numerous brand names throughout the world. Borate treated wood is of low toxicity to humans, and does not contain copper or other heavy metals. However, unlike most other preservatives, borate compounds do not become fixed in the wood and can readily be leached out. Therefore, borates should not be used where they will be exposed to rain, water or ground contact.

Recent interest in low toxicity timber for residential use, along with new regulations restricting some wood preservation agents, has resulted in a resurgence of the use of borate treated wood for floor beams and internal structural members.

Inorganic Boron (Borax–Boric Acid)
Borate preservatives are readily soluble in water and highly leachable and should be used only above ground where the wood is protected from wetting. When used above ground and protected from wetting, this preservative is very effective against decay, termites, beetles, and carpenter ants. Inorganic boron (SBX) is listed in AWPA standards for protected applications such as framing lumber. The solid or treating solution for borate preservatives (borates) should be greater than 98% pure, on an anhydrous basis (AWPA P5).

Acceptable borate compounds are sodium octaborate, sodium tetraborate, sodium pentaborate, and boric acid. These compounds are derived from the mineral sodium borate, which is the same material used in laundry additives.

Sodium Silicate-based Preservatives
Sodium silicate is produced by fusing sodium with sand or heating both ingredients under pressure. It has been in use since the 19th century. It can be a deterrent against insect attack and possesses minor flame-resistant properties; however, it is easily washed out of wood by moisture, forming a flake-like layer on top of the wood. One company, Timber Treatment Technology, LLC, has found that infusing timber with a chemical solution containing sodium silicate with a specified energy level applied yields wood that not only does not provide flake or layering on the wood, nor does it wash out as others have done in the past; and it provides processed timber that received a class A fire classification. Their processed wood also paints and stains as new wood does. TTT, LLC, sells these products under the name TimberSIL. Other uses include fixing pigments in paintings and cloth printing, and for preserving eggs.

EL2
EL2 is a waterborne preservative composed of the fungicide 4,5-dichloro-2-N-octyl-4-isothiazolin-3-one (DCOI), the insecticide imidacloprid, and a moisture control stabilizer (MCS). The ratio of actives is 98% DCOI and 2% imidacloprid, but the MCS is also considered to be a necessary component to ensure preservative efficacy. EL2 is currently listed in AWPA standards for above-ground applications only (Table 15–1).

KDS
KDS and KDS Type B (KDS–B) utilize copper and polymeric betaine as the primary active ingredients. The KDS formulation also contains boron, and has an actives composition of 41% copper oxide, 33% polymeric betaine, and 26% boric acid. KDS–B does not contain boron and has an actives composition of 56% copper oxide and 44% polymeric betaine. KDS is listed for treatment of commodities used above ground and for general use in contact with soil or fresh water. It is not listed for soil or fresh water contact in severe exposures. The listing includes treatment of common pine species as well as Douglas-fir and western hemlock. KDS–B is currently in the process of obtaining listings for specific commodities. The appearance of KDS-

treated wood is similar to that of wood treated with other alkaline copper formulations (light green–brown). It has some odor initially after treatment, but this odor dissipates as the wood dries.

Oligomeric Alkylphenol Polysulfide (PXTS)
PXTS is a recently developed and somewhat unusual preservative system. It is an oligomer formed by the reaction of cresylic acid and sulfur chlorides in the presence of excess sulfur. PXTS is a solid at room temperature but becomes a liquid when heated to above approximately 58 °C. It can also be dissolved and diluted in some aromatic and organic chlorinated solvents. PXTS is not currently listed for treatment of any commodities and is currently not commercially available.

Propiconazole and Tebuconazole
Propiconazole and tebuconazole are organic triazole biocides that are effective against wood decay fungi but not against insects (AWPA P5, P8). They are soluble in some organic solvents but have low solubility in water and are stable and leach resistant in wood. Propiconazole and tebuconazole are currently components of waterborne preservative treatments used for pressure-treatment of wood in the United States, Europe, and Canada. They are also used as components of formulations used to provide mold and sapstain protection. Propiconazole is also standardized for use with AWPA P9 Type C or Type F organic solvents.

Propiconazole–Tebuconazole–Imidacloprid (PTI)
PTI is a waterborne preservative solution composed of two fungicides (propiconazole and tebuconazole) and the insecticide imidacloprid. It is currently listed in AWPA standards for above-ground applications only. The efficacy of PTI is enhanced by the incorporation of a water-repellent stabilizer in the treatment solutions, and lower retentions are allowed with the stabilizer.

ESR–1721
ESR–1721 recognizes three preservative formulations. Two are the same formulations of copper azole (CA–B and CA–C) also listed in AWPA standards. The other (referred to here as ESR–1721) uses particulate copper that is ground to sub-micron dimensions and dispersed in the treatment solution. Wood treated with ESR–1721 has a lighter green color than the CA–B or CA–C formulations because the copper is not dissolved in the treatment solution. All three formulations are listed for treatment of commodities used in a range of applications, including contact with soil or freshwater. Use of ESR–1721 (dispersed copper) is currently limited to easily treated pine species.

ESR–1980
ESR–1980 includes a listing for both the AWPA standardized formulation of ACQ–D and a waterborne, micronized copper version of alkaline copper quat (referred to here as ESR–1980). The formulation is similar to ACQ in that the active ingredients are 67% copper oxide and 33% quaternary ammonium compound. However, in ESR–1980 the copper is ground to sub-micron dimensions and suspended in the treatment solution instead of being dissolved in ethanolamine. The treated wood has little green color because the copper is not dissolved in the treatment solution. The use of the particulate form of copper is currently limited to the more easily penetrated pine species, but efforts are underway to adapt the formulation for treatment of a broader range of wood species. ESR–1980 is listed for treatment of commodities used in both above-ground and ground-contact applications.

ESR–2067
ESR–2067 is an organic waterborne preservative with an actives composition of 98% tebuconazole (fungicide) and 2% imidacloprid (insecticide). The treatment does not impart any color to the wood. It is currently listed only for treatment of commodities that are not in direct contact with soil or standing water.

ESR–2240
ESR–2240 is a waterborne formulation that utilizes finely ground (micronized) copper in combination with tebuconazole in an actives ratio of 25:1. It is listed for above-ground and ground-contact applications. In addition to wood products cut from pine species, ESR–2240 can be used for treatment of hem–fir lumber and Douglas-fir plywood.

ESR–2325
ESR–2325 is another waterborne preservative that utilizes finely ground copper particles and tebuconazole as actives. The ratio of copper to tebuconazole in the treatment solution is 25:1. Its use is currently limited to more readily treated species such as the Southern Pine species group, but Douglas-fir plywood is also listed. ESR–2315 is listed for treatment of wood used above-ground and in contact with soil or fresh water.

ESR–2711
ESR–2711 combines copper solubilized in ethanolamine with the fungicide 4,5-dichloro-2-N-octyl-4-isothiazolin-3-one (DCOI). The ratio of copper (as CuO) to DCOIT ranges from 10:1 to 25:1. The ESR listing provides for both above-ground and ground-contact applications.

Oil-Borne or Oil-Type Wood Preservatives Sub-Section

Oil-type wood preservatives are some of the oldest preservatives, and their use continues in many applications. Wood does not swell from treatment with preservative oils, but it may shrink if it loses moisture during the treating process. Creosote and solutions with heavy, less volatile petroleum oils often help protect wood from weathering but may adversely influence its cleanliness, odor, color, paintability, and fire performance. Volatile oils or solvents with oil-borne preservatives, if removed after treatment, leave the wood cleaner than do the heavy oils but may not provide as much protection. Wood treated with some preservative oils can be glued satisfactorily, although special processing or cleaning may be required to remove surplus oils from surfaces before spreading the adhesive.

Coal-Tar Creosote and Creosote Solutions
Coal-tar creosote (creosote) is a black or brownish oil made by distilling coal tar that is obtained after high-temperature carbonization of coal. Advantages of creosote are (a) high toxicity to wood-destroying organisms; (b) relative insolubility in water and low volatility, which impart to it a great degree of permanence under the most varied use conditions; (c) ease of application; (d) ease with which its depth of penetration can be determined; (e) relative low cost (when purchased in wholesale quantities); and (f) lengthy record of satisfactory use. Creosote is commonly used for heavy timbers, poles, piles, and railroad ties.

AWPA Standard P1/P13 provides specifications for coal-tar creosote used for preservative treatment of piles, poles, and timber for marine, land, and freshwater use. The character of the tar used, the method of distillation, and the temperature range in which the creosote fraction is collected all influence the composition of the creosote, and the composition may vary within the requirements of standard specifications. Under normal conditions, requirements of these standards can be met without difficulty by most creosote producers.

Coal tar or petroleum oil may also be mixed with coal-tar creosote, in various proportions, to lower preservative costs. AWPA Standard P2 provides specifications for coal-tar solutions. AWPA Standard P3 stipulates that creosote–petroleum oil solution shall consist solely of specified proportions of 50% coal-tar creosote by volume (which meets AWPA standard P1/P13) and 50% petroleum oil by volume (which meets AWPA standard P4). However, because no analytical standards exist to verify the compliance of P3 solutions after they have been mixed, the consumer assumes the risk of using these solutions.

These creosote solutions have a satisfactory record of performance, particularly for railroad ties and posts where surface appearance of the treated wood is of minor importance. Compared with straight creosote, creosote solutions tend to reduce weathering and checking of the treated wood. These solutions have a greater tendency to accumulate on the surface of the treated wood (bleed) and penetrate the wood with greater difficulty because they are generally more viscous than is straight creosote. High temperatures and pressures during treatment, when they can be safely used, will often improve penetration of high-viscosity solutions.

Although coal-tar creosote or creosote solutions are well suited for general outdoor service in structural timbers, creosote has properties that are undesirable for some purposes. The color of creosote and the fact that creosote-treated wood usually cannot be painted satisfactorily make this preservative unsuitable where appearance and paintability are important.

The odor of creosote-treated wood is unpleasant to some people. Also, creosote vapors are harmful to growing plants, and foodstuffs that are sensitive to odors should not be stored where creosote odors are present. Workers sometimes object to creosote-treated wood because it soils their clothes, and creosote vapor photosensitizes exposed skin.

With precautions to avoid direct skin contact with creosote, there appears to be minimal danger to the health of workers handling or working near the treated wood. The EPA or the wood treaters should be contacted for specific information on this subject.

In 1986, creosote became a restricted-use pesticide, and its use is currently restricted to pressure-treatment facilities. For use and handling of creosote-treated wood, refer to the EPA-approved Consumer Information Sheet.

Freshly creosoted timber can be ignited and burns readily, producing a dense smoke. However, after the timber has seasoned for some months, the more volatile parts of the oil disappear from near the surface and the creosoted wood usually is little, if any, easier to ignite than untreated wood. Until this volatile oil has evaporated, ordinary precautions should be taken to prevent fires. Creosote adds fuel value, but it does not sustain ignition.

Other Creosotes

Creosotes distilled from tars other than coal tar have been used to some extent for wood preservation, although they are not included in current AWPA specifications. These include wood-tar creosote, oil-tar creosote, and water–gas-tar creosote. These creosotes provide some protection from decay and insect attack but are generally less effective than coal-tar creosote.

Pentachlorophenol Solutions

Water-repellent solutions containing chlorinated phenols, principally pentachlorophenol (penta), in solvents of the mineral spirits type, were first used in commercial dip treatments of wood by the millwork industry in about 1931. Commercial pressure treatment with pentachlorophenol in heavy petroleum oils on poles started in about 1941, and considerable quantities of various products soon were pressure treated. AWPA Standard P8 defines the properties of pentachlorophenol preservative, stating that pentachlorophenol solutions for wood preservation shall contain not less than 95% chlorinated phenols, as determined by titration of hydroxyl and calculated as pentachlorophenol.

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AWPA standard P9 defines solvents and formulations for organic preservative systems. The performance of pentachlorophenol and the properties of the treated wood are influenced by the properties of the solvent used. A commercial process using pentachlorophenol dissolved in liquid petroleum gas (LPG) was introduced in 1961, but later research showed that field performance of penta–LPG systems was inferior to penta–P9 systems.

Thus, penta–LPG systems are no longer used. The heavy petroleum solvent included in AWPA P9 Type A is preferable for maximum protection, particularly when wood treated with pentachlorophenol is used in contact with the ground. The heavy oils remain in the wood for a long time and do not usually provide a clean or paintable surface.

Because of the toxicity of pentachlorophenol, care is necessary when handling and using it to avoid excessive personal contact with the solution or vapor. Do not use indoors or where human, plant, or animal contact is likely. Pentachlorophenol became a restricted-use pesticide in November 1986 and is currently only available for use in pressure treatment. For use and handling precautions, refer to the EPA-approved Consumer Information Sheet.

The results of pole service and field tests on wood treated with 5% pentachlorophenol in a heavy petroleum oil are similar to those with coal-tar creosote. This similarity has been recognized in the preservative retention requirements of treatment specifications.

Pentachlorophenol is effective against many organisms, such as decay fungi, molds, stains, and insects. Because pentachlorophenol is ineffective against marine borers, it is not recommended for the treatment of marine piles or timbers used in coastal waters.

Copper Naphthenate
Copper naphthenate is an organometallic compound formed as a reaction product of copper salts and naphthenic acids that are usually obtained as byproducts in petroleum refining. It is a dark green liquid and imparts this color to the wood. Weathering turns the color of the treated wood to light brown after several months of exposure. The wood may vary from light brown to chocolate brown if heat is used in the treating process. AWPA P8 standard defines the properties of copper naphthenate, and AWPA P9 covers the solvents and formulations for organic preservative systems.

Copper naphthenate is effective against wood-destroying fungi and insects. It has been used commercially since the 1940s and is currently standardized for a broad range of applications. Copper naphthenate is not a restricted-use pesticide but should be handled as an industrial pesticide. It may be used for superficial treatment, such as by brushing with solutions with a copper content of 1% to 2% (approximately 10% to 20% copper naphthenate). Water-based formulations of copper naphthenate may also be available.

Oxine Copper (copper-8-quinolinolate)
Oxine copper (copper-8-quinolinolate) is an organometallic compound, and the formulation consists of at least 10% copper-8-quinolinolate, 10% nickel-2-ethylhexanoate, and 80% inert ingredients (AWPA P8). It is accepted as a stand-alone preservative for aboveground use for sapstain and mold control and is also used for pressure treating. A water-soluble form can be made with dodecylbenzene sulfonic acid, but the solution is corrosive to metals.

Oxine copper solutions are greenish brown, odorless, toxic to both wood decay fungi and insects, and have a low toxicity to humans and animals. Because of its low toxicity to humans and animals, oxine copper is the only EPA-registered preservative permitted by the U.S. Food and Drug Administration for treatment of wood used in direct contact with food. Some examples of its uses in wood are commercial refrigeration units, fruit and vegetable baskets and boxes, and water tanks. Oxine copper solutions have also been used on non-wood materials, such as webbing, cordage, cloth, leather, and plastics.

Zinc Naphthenate
Zinc naphthenate is similar to copper naphthenate but is less effective in preventing decay from wood-destroying fungi and mildew. It is light colored and does not impart the characteristic greenish color of copper naphthenate, but it does impart an odor. Waterborne and solvent-borne formulations are available. Zinc naphthenate is not widely used for pressure treating.

3-Iodo-2-Propynyl Butyl Carbamate
3-Iodo-2-propynyl butyl carbamate (IPBC) is a fungicide that is used as a component of sapstain and millwork preservatives. It is also included as a fungicide in several surface-applied water-repellent-preservative formulations. Waterborne and solvent-borne formulations are available. Some formulations yield an odorless, treated product that can be painted if dried after treatment. It is listed as a pressure-treatment preservative in the AWPA standards but is not currently standardized for pressure treatment of any wood products. IPBC also may be combined with other fungicides, such as didecyldimethylammonium chloride in formulations used to prevent mold and sapstain.

IPBC/Permethrin
IPBC is not an effective insecticide and has recently been standardized for use in combination with the insecticide permethrin (3-phenoxybenzyl-(1R,S)-cis, trans-2, 2-dimethyl-3-(2,2-dichlorovinyl) cycloproanecarboxylate) under the designation IPBC/PER. Permethrin is a synthetic pyrethroid widely used for insect control in agricultural and structural applications.

The ratio of IPBC to permethrin in the IPBC/PER varies between 1.5:1 and 2.5:1. The formulation is carried in a light solvent such as mineral spirits, making it compatible with composite wood products that might be negatively affected by the swelling associated with water-based pressure treatments. The IPBC/PER formulation is intended only for use in above-ground applications. The formulation is listed as a preservative in AWPA standards, but at the time this chapter was finalized it had not yet been standardized for treatment of any commodities.

Alkyl Ammonium Compounds
Alkyl ammonium compounds such as didecyldimethylammonium chloride (DDAC) or didecyldimethylammonium carbonate (DDAC)/bicarbonate (DDABC) have some efficacy against both wood decay fungi and insects. They are soluble in both organic solvents and water and are stable in wood as a result of chemical fixation reactions. DDAC and DDABC are currently being used as a component of alkaline copper quat (ACQ) (see section on Waterborne Preservatives) for above-ground and ground-contact applications and as a component of formulations used for sapstain and mold control.

4,5-Dichloro-2-N-Octyl-4-Isothiazolin-3-One (DCOI)
4,5-dichloro-2-N-octyl-4-isothiazolin-3-one (DCOI) is a biocide that is primarily effective against wood decay fungi. It is soluble in organic solvents but not in water, and it is stable and leach resistant in wood. The solvent used in the formulation of the preservative is specified in AWPA P9 Type C. DCOI can be formulated to be carried in a waterborne system, and it is currently used as a component in the waterborne preservative EL2. It has also recently been proposed for use as co-biocide in a copper ethanolamine formulation referred to as ACD.

Chlorpyrifos
Chlorpyrifos (CPF) is an organophosphate insecticide that has been widely used for agricultural purposes. It has been standardized by the AWPA as a preservative but is not currently used as a component of commercial pressure treatments.

Chloropyrifos is not effective in preventing fungal attack and should be combined with an appropriate fungicidal preservative for most applications.

Treatments for Wood Composites

Many structural composite wood products, such as glued-laminated beams, plywood, and parallel strand and laminated veneer lumber, can be pressure-treated with wood preservatives in a manner similar to lumber. However, flake- or fiber-based composites are often protected by adding preservative during manufacture. A commonly used preservative for these types of composites is zinc borate. Zinc borate is a white, odorless powder with low water solubility that is added directly to the furnish or wax during panel manufacture. Zinc borate has greater leach resistance than the more soluble forms of borate used for pressure treatment and thus can be used to treat composite siding products that are exposed outdoors but partially protected from the weather. Zinc borate is currently listed in AWPA Commodity Standard J for non-pressure treatment of laminated strand lumber, oriented strandboard, and engineered wood siding. The standard requires that these products have an exterior coating or laminate when used as siding. Another preservative that has been used to protect composites is ammoniacal copper acetate, which is applied by spraying the preservative onto the OSB flakes before drying.

Fire Retardant Treated

This treated wood utilizes a fire retardant chemical that remains stable in high temperature environments. The fire retardant is applied under pressure at a wood treating plant like the preservatives described above, or applied as a surface coating.

In both cases, treatment provides a physical barrier to flame spread. The treated wood chars but does not oxidize. Effectively this creates a convective layer that transfers flame heat to the wood in a uniform way which significantly slows the progress of fire to the material. There are several commercially available wood-based construction materials using pressure-treatment (such as those marketed in the United States and elsewhere under the trade names of 'Dricon', 'D-Blaze,' and 'Pyro-Guard', as well as factory-applied coatings under the trade names of 'PinkWood' and 'BluWood'. Some site-applied coatings as well as brominated fire retardants have lost favor due to safety concerns as well as concerns surrounding the consistency of application. Specialized treatments also exist for wood used in weather-exposed applications.

Toxic Oil-borne Preservatives

These include pentachlorophenol and creosote. They are toxic, have an unpleasant odor and are generally not used in consumer products.

Coal-tar Creosote

Creosote is a tar-based preservative that has been commonly used for telephone poles and railroad ties. Creosote is one of the oldest wood preservatives, and was originally derived from a wood distillate. These days virtually all creosote is manufactured from the distillation of coal tar. It often collects inside chimneys and may cause a fire hazard. Creosote is regulated as a pesticide and is not usually sold to the general public. It is still used for railroad ties (also called railway sleepers and cross ties) and utility poles.

Linseed Oil
Linseed oil is used to preserve Wood fences, log cabins, and wood furniture. (Such woods as Willow, Pine, oak and exc.) The function of linseed oil as a preservative is believed to be related to its action as a water repellent and drying agent rather than a direct biocidal activity.

A number of companies have developed natural-oil-only-based treatments; no synthetic preservative such as permethrin is added. Menz Holz OHT use autoclave impregnation with linseed, sunflower and rapeseed oil for 6 to 8 hours.

Naphthenic Acid
Naphthenic acid is the name for an unspecific mixture of several cyclopentyl and cyclohexyl carboxylic acids with molecular weight of 120 to well over 700 atomic mass units. The main fraction are carboxylic acids with a carbon backbone of 9 to 20 carbons. The naphtha fraction of the crude oil refining is oxidized and yields naphthenic acid. The composition differs with the crude oil composition and the conditions during refining and oxidation. Naphthenic acids are present in crude oil and leads to corrosion problems within the oil refineries; therefore "naphthenic acid corrosion" phenomena are well researched. Crude oils with a high content of naphthenic acids are often referred to as high TAN (Total Acid Number) crude oils or high acid crude oil (HAC). There is also a conference called the High TAN Crude Conference which was first organized in 2005.

Mixtures of a flammable substance and naphthenic and palmitic acid aluminum salts were discovered during World War II to make napalm. These acids caused flammable hydrocarbons to gel.

Other uses of naphthenic acids depend on the refinement of the material. Naphthenic acid is used in corrosion inhibitors, wood preservatives, lubricant and fuel additives, driers for paints and inks, and in the production of metal soaps.

Naphthenates
Naphthenates are the salts of naphthenic acids. These salts have industrial applications including synthetic detergents, lubricants, corrosion inhibitors, fuel and lubricating oil additives, wood preservations, insecticides, fungicides, acaricides, wetting agents, and oil drying agents used in painting and wood surface treatment.

Industrially useful naphthenates include barium naphthenate, calcium naphthenate, cobalt naphthenate, copper naphthenate, lead naphthenate, magnesium naphthenate, manganese naphthenate, nickel naphthenate, sodium naphthenate, vanadyl naphthenate and zinc naphthenate.

2017 Changes to EPA’s Farm Worker Protection Standard
In late 2015 the Environmental Protection Agency issued the long awaited revision to the Worker Protection Standard (WPS). This law it is now technically active and it will be enforced. Please keep in mind that the WPS covers both restricted use AND general use pesticides. This course is not for worker and/or handler training. Always follow the label and your State Pesticide Agency rules.

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Other Wood Preservative Emulsions Sub-Section

Light Organic Solvent Preservatives (LOSP)

This class of timber treatments use white spirit, or light oils such as kerosene, as the solvent carrier to deliver preservative compounds into timber. Synthetic pyrethroids are typically used as an insecticide, such as permethrin, bifenthrin or deltamethrin. The most common formulations use Permethrin as an insecticide, and Propaconazole and Tebuconazole as fungicides. While still using a chemical preservative, this formulation contains no heavy-metal compounds.

With the introduction of strict volatile organic compound (VOC) laws in the European Union, LOSPs have disadvantages due to the high cost and long process times associated with vapor-recovery systems. LOSPs have been emulsified into water-based solvents. While this does significantly reduce VOC emissions, the timber swells during treatment, removing many of the advantages of LOSP formulations.

This publication contains pesticide recommendations that are subject to change at any time. These recommendations are provided only as a guide. It is always the pesticide applicator's responsibility, by law, to read and follow all current label directions for the specific pesticide being used. Due to constantly changing labels and product registration, some of the recommendations given in this writing may no longer be legal by the time you read them. If any information in these recommendations disagrees with the label, the recommendation must be disregarded. No endorsement is intended for products mentioned, nor is criticism meant for products not mentioned. The author and Technical Learning College (TLC) assume no liability resulting from the use of these recommendations.

New Technologies

Glass Fortified Wood

Glass Fortified Wood (glass wood) is lumber that has gone through a process that intermixes a non-toxic sodium silicate (water glass) based formula throughout the wood fibers protecting the wood from fire, rot and insect damage. With glass encapsulating the wood fibers, the lumber becomes harder and the strength is increased. Glass wood can be used for in ground contact applications, in water applications and it is Class-A fire retardant.

Wood Acetylation

Chemical modification of wood at the molecular level has been used to improve its performance properties. Many chemical reaction systems for the modification of wood, especially those using various types of anhydrides, have been published; however, the reaction of wood with acetic anhydride has been the most studied.

The physical properties of any material are determined by its chemical structure. Wood contains an abundance of chemical groups called free hydroxyls. Free hydroxyl groups readily absorb and release water according to changes in the climatic conditions to which they are exposed. This is the main reason why wood's dimensional stability is impacted by swelling and shrinking. It is also believed that the digestion of wood by enzymes initiates at the free hydroxyl sites - which is one of the principal reasons why wood is prone to decay.

Acetylation effectively changes the free hydroxyls within wood into acetyl groups. This is done by reacting the wood with acetic anhydride, which comes from acetic acid (the main component of vinegar).

When free hydroxyl groups are transformed to acetyl groups, the ability of the wood to absorb water is greatly reduced, rendering the wood more dimensionally stable and, because it is no longer digestible, extremely durable. In general, softwoods naturally have an acetyl content between 0.5 to 1.5% and more durable hardwoods between 2 to 4.5%. Acetylation takes wood well beyond these levels with corresponding benefits. These include an extended coatings life due to acetylated wood acting as a more stable substrate for paints and translucent coatings. Acetylated wood is non-toxic and does not have the environmental issues associated with traditional preservation techniques.

The acetylation of wood was first done in Germany in 1928 by Fuchs. In 1946, Tarkow, Stamm and Erickson first described the use of wood acetylation to stabilize wood from swelling in water. Since the 1940s, many laboratories around the world have looked at acetylation of many different types of woods and agricultural resources.

In spite of the vast amount of research on chemical modification of wood, and, more specifically, on the acetylation of wood, commercialization did not come easily. The first patent on the acetylation of wood was filed by Suida in Austria in 1930. Later, in 1947, Stamm and Tarkow filed a patent on the acetylation of wood and boards using pyridine as a catalyst. In 1961, the Koppers Company published a technical bulletin on the acetylation of wood using no catalysis but with an organic co-solvent. In 1977, in Russia, Otlesnov and Nikitina came close to commercialization but the process was discontinued presumably because cost-effectiveness could not be achieved. In 2007 a London-based company, with production facilities in The Netherlands, achieved cost-effective commercialization and began large-scale production of acetylated wood.

Although many decay fungi may grow for long periods without producing any external evidence of their presence, others produce "fruiting bodies" on the surface of decaying wood. Fruiting bodies are usually "crusts" or shelf-like "brackets" which are a few inches or so in diameter.

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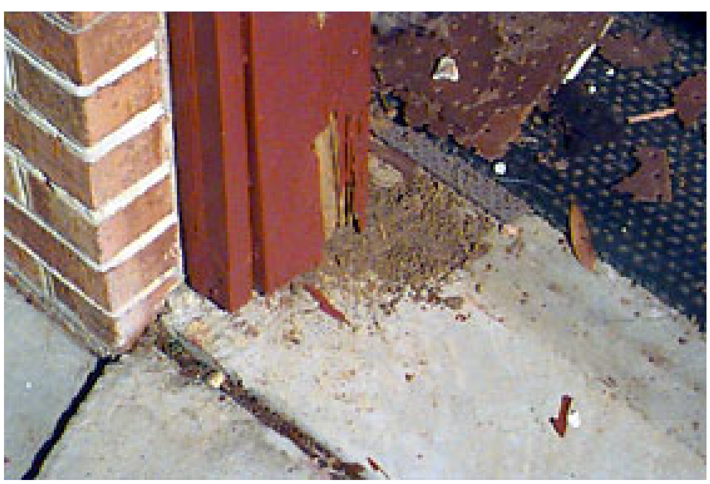
Preventing Future Termite Infestations Summary

The most effective and least expensive means of protecting buildings from the subterranean termite is to prevent infestations from developing in the first place. This includes eliminating existing colonies and potential food sources of colonies in the vicinity of new construction.

New Construction
New construction should also be pretreated with a soil termiticide prior to laying of concrete foundations and slabs. The surrounding grounds should be made less susceptible to infestation from expanding colonies by eliminating stumps and logs in the vicinity. Termites will readily tunnel through expanded (EPS) and extruded (XPS) polystyrene. These materials can lead to serious termite problems when used as exterior cladding below grade and such use is not recommended in areas where termites are common.

Mud Tube Removal
State regulations require pest control operators to remove termite tubes as part of a complete termite treatment. Removing the tubes provides a way to determine if a termite infestation remains active after treatment or if the termites reappear in the same area later. Scraping away mud tubes as the sole means of control can be impractical and is probably unwise in many cases (such as with slab construction). The tubes are an indication that termites are active around the house. What you cannot easily determine, even with a careful inspection, is whether termites may be active in a foundation or wall void or some other visually inaccessible area of your home.

Debris Removal
Although it is convenient, it is not a good idea to turn your crawlspace into a general storage area, particularly for items made of wood, cardboard or paper that can serve as food for termites. The same problem arises when tree stumps are left under houses during construction. State regulations require that termite treatments include the removal of cellulose debris of a size that can be removed with an ordinary garden rake. Removing the debris helps reduce food resources that could be used by termites. This topic is discussed under preventive measures.



Garage doorframes are often vulnerable to moisture and termite problems.

The following precautionary practices will discourage termite infestations.

1. Building sites should be cleared of stumps, roots or other woody material that remains beneath or adjacent to the building.
2. All stakes, forms (including those under concrete steps, cement slabs and pads) and building debris should be removed from beneath and adjacent to buildings. Do not backfill over such debris.
3. The site should be well drained so that moisture is not retained under, or adjacent to, a building. Downspouts should carry water away from the building.
4. Crawl spaces should be accessible, well ventilated and high enough to allow working space. Insufficient clearance also makes easy construction of termite shelter tubes from soil to wood. Make sure air flow through vents is not blocked by shrubbery or other materials.
5. Crawl spaces and basements should be kept clear of lumber, firewood, sawdust and other woody materials.
6. No wood (stair supports, posts or other wood) should project through concrete floors or foundations.
7. Foundations should be of concrete or masonry, and soil debris should be kept clear of wood resting on them. Make sure the foundation wall is high enough to allow sufficient top soil placement and still leave at least 15-20 cm of clearance between the bottom of siding or stucco and the ground.
8. Slabs, concrete floors and foundation joints should be sealed against moisture, and regularly inspected for cracks which should be immediately sealed.
9. Outside structures such as fences, railings, wooden planters, wooden sidewalks and stumps or trees should be well separated from houses or other buildings. Metal flashing can be installed to prevent the passage of termites. Most wood preservatives will discourage termites.
10. Do not stack firewood next to buildings, especially those with wood siding.
11. Avoid placing wood chips or bark mulch adjacent to the foundation. Use lava or other rock instead.
12. Avoid over-watering lawns and regularly check for leaks in underground irrigation systems and dripping faucets. This will also aid in discouraging leatherjacket (crane fly) infestations in lawns.

Buildings should be checked at least once a year for necessary maintenance of the above items and unsatisfactory conditions should be corrected. Surrounding grounds should be inspected for termites using wooden stakes and remedial action taken to prevent further spread of termites where detected.

During the construction phase, various methods have been developed to discourage termite infestations. These include appropriate placement of metal flashing or shields between the cement foundation the wooden structure, ensuring expansion joints are properly cured and that no spaces exist around utility pipes (sewer, electricity, natural gas lines) cut through the foundation or slab.

Control products containing inorganic borate can be applied to lumber at the time of construction, or later if exposed, to provide lifetime protection from infestation as long as the wood remains dry.

Remedial Control

Control of subterranean termites in buildings can be difficult and expensive. Chemical (termiticide) treatment is a proven means of protecting buildings from further damage by subterranean termites. The majority of treatments involves injection of a termiticide around the entire perimeter of the foundation and under the slab (called a full treatment) or may only require a partial treatment of the perimeter if the infestation is very localized. Some termiticides can be sprayed if the infestations are suited to this type of treatment. Therefore, as previously mentioned, it is important that a correct diagnosis and thorough inspection be made before any control measures are implemented.

This is best done through the services of a professional licensed pest control applicator, preferably someone with specialized knowledge and experience in termite control. Because it takes a long time for termites to cause appreciable damage, there is rarely need for immediate control action. Therefore, building owners should take the time to contact at least three operators to compare their diagnoses and competitive bids for the job.

A reliable pesticide applicator should provide the owner with a diagram of the inspected premises, indicating the points of entry and the location and the severity of infestations, and an estimate of the control costs along with an explanation of how the control measures are to be carried out. Be sure to give a written guarantee on the length of protection (usually years) the treatment will provide. Owners with buildings having hot-water heated basement floors should provide a diagram of the pipe layout if the floor is to be drilled to inject a termiticide under the slab.

Sodium Borate
Sodium Borate has been a popular alternative treatment for subterranean termites in the last few years. Popularized in the early 1990's with the advent of **BORACARE** (Sodium Borate and Glycol which acts as a penetrate), Sodium Borate is a form of Boric Acid, although it is not as refined as Boric Acid, but comes from the same basic element boron.

Sodium Borate acts by killing the bacterial protozoa in the termites' intestinal gut which acts as the termites' food processor. This bacterial protozoa actually digests the wood which the termite eats, and processes it into an energy source (sugar); the termite then excretes a wood pellet (frass).

When the termites digest wood containing sodium borate, the bacterial protozoa is killed which results in the termites not being able to digest their food. So, in essence, the termite starves to death. Sodium Borate is relatively inexpensive and is widely used in the termite control industry as a secondary backup treatment to a conventional soil treatment. Sodium Borate can also be used as a termite bait, and also as flea killer for carpets.

Timbor is easy to mix and apply. 1 lb. of Timbor mixes in 1 gallon of water--simply spray Timbor with a hand sprayer or apply liberally with a paint brush, roller etc., to bare wood surfaces such as wall studs, joists, etc. Timbor will saturate the wood and provide many years of protection against termites, carpenter ants, wood decay fungi, etc. Timbor is an excellent protection and is highly recommended.

New Methods of Termite Control
New methods of termite control are always being developed by researchers. Some examples include baits, sand barriers, the fungal pathogen Metarhizium anisopliae, and transmissible coatings.

One of my favorite treatment products but there are many others on the market. Always follow the instructions and please wear proper PPE.

2017 Changes to EPA's Farm Worker Protection Standard
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This course contains EPA's federal rule requirements. Please be aware that each state implements pesticide regulations that may be more stringent than EPA's regulations and these frequently are changed. Check with your state environmental/pesticide agency for more information.

The photograph above is of a tropical termite nest will often house parrots. The parrots will enter through the bottom and the young will eat the termite larva. Funny to say, but many of us in California and Arizona are dealing with parrots as a pest. We will try to tackle this subject in a future course.

The FST attacks structural lumbers and living plants because they are sources of cellulose. A single colony of C. formosanus may produce over 70,000 alates. After a brief flight, alates shed their wings.

Females immediately search for nesting sites with males following closely behind. When the pair finds a moist crevice with wooden materials, they form the royal chamber and lay approximately 15 to 30 eggs.

Within two to four weeks, young termites hatched from the eggs. The reproductives nurse the first group of young termites until they reach third instar. One to two months later, the queen lays the second batch eggs which would be eventually nursed by termites from the first egg batch. It may take three to five years before a colony reach substantial number to cause severe damage and produce alates.

A mature colony contains distinct groups called castes. These castes look different from one another and each has a special duty within the colony. The king and queen are the primary reproductives and are responsible for reproduction. If the queen or king dies or the colony becomes large, secondary reproductives may form and begin reproduction. Soldiers defend the colony against predators and other natural enemies. Workers take care of and feed the larvae, reproductives and soldiers, tend the eggs, build and maintain the nest, and search for food. Alate nymphs become alates when they are fully grown.

Formosan termite swarms usually occur from April through July on calm, warm, and humid evenings. Swarms are quite large with up to tens of thousands of alates. The swarmers are attracted to lights and are often found around windows, light fixtures, windowsills, and spider webs in lighted areas.

After swarming and landing on the ground, the alates break off their wings and search for a mate. Once a mate is found the male and female search for a crevice in damp ground or wood, hollow out a small chamber, and crawl inside. The pair, now known as the king and queen, mate and within a few days the queen starts laying eggs. The young, known as larvae, hatch from the eggs and are fed by the king and queen.

Topic 4 - Termite and Wood Destroyer Management Post Quiz
Answers in Rear after the Glossary

1. Permethrin is a narrow-spectrum pyrethroid insecticide.
True or False

Borates
2. "Borate" is a generic term for compounds containing the elements boron and?

Pyrroles
3. Chlorfenapyr is registered as a termiticide under which tradename?

Fiproles (or Phenylpyrazoles)
4. Fipronil is the only insecticide in this new class, introduced in 1990 and registered in the U.S. in 1996. It is marketed as a termiticide under which tradename?

Crawl Spaces
5. Do not treat soil in crawl space area with a broadcast insecticide spray. Establish vertical barriers by rodding and/or trenching procedures. A shallow trench should not be wider than 6 inches. Space rod holes about 1 to 1 1/2 feet apart. Apply insecticide at the rate of 4 gallons per 10 linear feet per foot of depth.
True or False

Bath Traps
6. Soil may require insecticide treatment if it is exposed beneath and around plumbing/waste pipe entrances through a concrete slab. Remove any wood or other debris and treat the soil by rodding or flooding with an insecticide solution.
True or False

Treatment of Secondary Subterranean Termite Colony
7. Apply insecticide to infested wood and void spaces with a crack and crevice injector.
True of False

New Construction
8. Termites will readily tunnel through expanded (EPS) and extruded (XPS) polystyrene. These materials can lead to serious termite problems when used as exterior cladding below grade and such use is not recommended in areas where termites are common.
True or False

9. Which action provides a way to determine if a termite infestation remains active after treatment or if the termites reappear in the same area later?

10. During which phase, various methods have been developed to discourage termite infestations? These include appropriate placement of metal flashing or shields between the cement foundation the wooden structure, ensuring expansion joints are properly cured and that no spaces exist around utility pipes (sewer, electricity, natural gas lines) cut through the foundation or slab.

Topic 5 - Advanced Termite/Ant Management Section

Topic 5 - Section Focus: You will learn the fundamentals of advanced termite and related wood destroyer management and control techniques. At the end of this section, you will be able to understand and describe advanced pest management, control and elimination techniques of wood destroyers. There is a post quiz at the end of this section to review your comprehension and a final examination in the Assignment for your contact hours.

Tenting

Fumigation Detailed

We started with an introduction to fumigation in the earlier section. We will now go deeper into this highly dangerous pesticide application method. It may be in the top of the most dangerous pesticide application other than "electrical discharge methods". Therefore, we will again cover the basics.

Fumigation is a pest control method that fills an entire building with fumigants that will either poison or suffocate the pests inside. It is often the only way to get rid of termites and wood boring insects that are causing extensive damage to wooden areas in a home or factory. The building to be fumigated is first completely covered with large tarpaulins or 'tents'. The fumigant is then released inside the building. The building will remain covered for a certain period of time. This allows the fumigant to penetrate all areas and kill the pests. After this, the building is ventilated so that the poison can disperse. It will then be safe for humans to re-enter the premises. The reason for the tarpaulins is to prevent the fumigant escaping and causing potential harm to neighboring people / buildings.

The pest fumigation process can take up to a week to complete, depending on the level of infestation and the size of the building. Methyl bromide was the most commonly used fumigant until it was banned because it harms the ozone layer. Present day fumigants include phosphine, chloropicrin, hydrogen cyanide, methyl isocyanate, Iodoform, and sulfuryl fluoride. A popular choice among many pest control services is sulfuryl fluoride. Check with your state agency on this rule. More on these fumigants in few minutes.

Tenting
Structural fumigating techniques differ from building to building, but in houses a rubber tent is often placed over the entire house while the pesticides are being released into the vacant residence. This process is called tent fumigation or "tenting". The sealed tent concentrates the poisonous gases and prevents them from escaping into the neighborhood. The process can take up to a week depending on the fumigant used, which in turn depend on the severity of infestation and size of the building. Fumigation is a very hazardous operation.

Generally, it is a legal requirement that the operator, carrying out the fumigation operation, holds official certification to perform the fumigation, as the chemicals used are toxic to most forms of life, including humans. Check with your state agency on this rule.

Post Operation Ventilation
Post operation ventilation of the area is a critical safety aspect of fumigation. It is important to distinguish between the pack or source of the fumigant gas and the environment which has been fumigated. While the fumigant pack may be safe and spent, the space will still hold the fumigant gas until it has been ventilated.

Fumigation Application
Application means introducing the solid, liquid or gas fumigant product into an empty space, an area containing a commodity, or a rodent burrow. In most cases with space fumigations, the fumigant is applied from outside without actually entering the structure. Application methods differ depending upon (i) the fumigant formulation being used, (ii) site/area being treated and (iii) the target pest. For example, fumigation of infested grain using a solid fumigant product may involve pellets or tablets walked into the surface of the grain, applying pellets down into the grain mass with a probe, or the use of an automatic dispenser which uniformly applies the fumigant throughout the grain mass as the bin or silo is filled. When liquid phosphine (liquefied gas or liquefied gas under pressure) is used as a fumigant, it is introduced into the treated site with approved tubing where it disperses as a gas for quick distribution throughout the fumigated area. Outdoor rodent burrows are fumigated by placing pellets or tablets into the burrow and lightly sealing the entrance/exit.

Structure
“Structure” means any building regardless of its design or the type of material used in its construction, whether public or private, vacant or occupied the foundation thereof, and the adjacent enclosed areas. It shall also include but shall not be limited to warehouses, trucks, boxcars, railcars, ship holds, boxes, tarp covered stacks, other vehicles, or the contents thereof, and fumigation vaults.

Adjacent Enclosed Area
A space that is located next to or near a structure that is being fumigated and has the potential for the phosphine gas to enter into and accumulate or remain in this area.

If people or domestic animals may enter into this area during the fumigation or aeration process, you are required to conduct monitoring to be sure no one is exposed above the permitted level of 0.3 ppm on an 8-hour time weighted average.

Fumigation Management Plan

A Fumigation Management Plan (FMP) is a written description of the steps designed to plan for a safe, legal and effective fumigation. It is important to note that some plans will be more comprehensive than others.

The certified applicator and owner of the property to be fumigated must address characterization of the structure and/or area and include all safety requirements in the plan prior to application. A new FMP is not needed for every fumigation of an individual facility if conditions will not vary other than general updates such as temperature and humidity recordings. The FMP and related documentation, including monitoring records, must be maintained for a minimum of 2 years.

Although the Federal labeling allows trained workers to do certain activities associated with fumigations, some states may be more restrictive than others and require that a certified applicator always be physically present on site.

Therefore, before proceeding with a fumigation, the client and/or certified applicator should consult with the State lead pesticide regulatory agency to determine regulatory status, requirements, and restrictions for use of fumigants in that state.

Most fumigation activities are carried out by a certified applicator or by a trained worker under the direct supervision of a certified applicator. As mentioned above, state restrictions and requirements vary. In some states certain specific activities can be turned over to a trained worker to complete the fumigation independently in the absence of a certified applicator. The CA may remain in voice contact if needed but not physically present.

These Specific Activities Include:

- ✓ Monitoring the fumigation site for gas leaks and accumulation of phosphine gas above the permitted limit
- ✓ Completing the aeration of a structure after the aeration has progressed and stabilized removal of placards after the aeration is completed
- ✓ Receiving, aerating and releasing the content of a vehicle fumigated in-transit (Note: transporting vehicles under fumigation over public roads is prohibited)
- ✓ Transfer of an unaerated commodity from one in-transit container to another storage site to continue with the fumigation disposal of any spent fumigant
- ✓ Maintenance of written records of all permitted actions performed.

Monitoring for Safety

Monitoring for safety is always required unless it can be confirmed/concluded by the certified applicator that there is no possibility of exposure to phosphine at or above the allowable limits to workers or bystanders. Monitoring must be done if there is even the slightest possibility of exposure. Exposures to phosphine must not exceed the 8-hour Time Weighted Average of 0.3 ppm or the 15-minute Short-Term Exposure Limit (STEL) of 1.0 ppm.

Under Direct Supervision

When a fumigation product is being applied it must be under the supervision of a certified applicator. In many states "Under direct supervision" means the act or process whereby application of a pesticide is made by a competent person acting under the instructions and control of a licensee or certified applicator who is responsible for the action of that person and who is available if and when needed, even though such licensee or certified applicator is not physically present at the time and place the pesticide is applied. However, in some states certain activities as noted previously may not be performed without the physical presence of the CA.

Voice Contact

Voice contact means that the certified applicator (CA) is supervising the trained worker(s) by maintaining a voice communication, with or without being physically present on site. Voice contact when the certified applicator is present on-site may be accomplished by the use of phones or walkie-talkies in a situation where the CA and the trained worker are not working at a visible distance to each other (ex. when working at a large facility where several sheds or bins will be fumigated at the same time or while trouble shooting a gas leak after the fumigation has started). When both parties are not physically present on site, voice contact may be accomplished through the use of phones or walkie-talkies.

Safe Disposal

Fumigation starts with the introduction of the fumigant into a space or commodity that has been properly placarded and secured. It ends when aeration has rendered the space or commodity at or below established safe limits specified in the product labeling. Safe disposal of the spent fumigant, according to label directions, must also be conducted following completion of the fumigation.

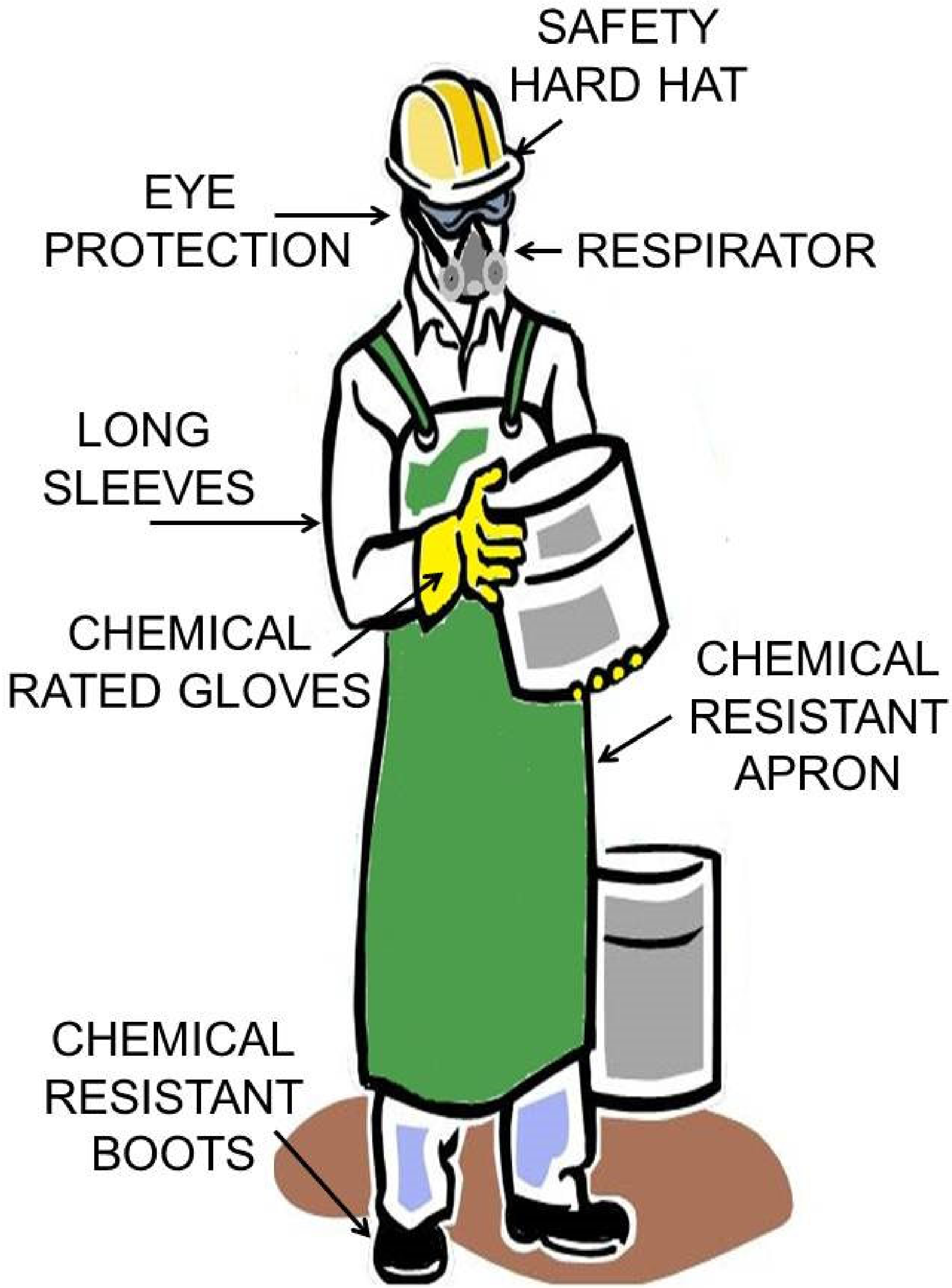
Fumigation Safety Rules

Phosphine fumigants are valuable tools as long as they are used properly. Read and follow all instructions on the label, including the applicator's manual to ensure a safe and effective fumigation. Store all containers of fumigant under lock and key, and keep a careful inventory so each container and package is accounted for. If you discover that any fumigant has been stolen, you are required to report the theft immediately to your local law enforcement authorities. Make sure the storage area is properly placarded as a pesticide storage area. The applicator's manual specifies what must be on the placards for an area where phosphine fumigants will be stored. Never store fumigants inside a home or in any structure where humans or animals live. Just-in-time delivery of exactly the right amount of fumigant is the safest practice.

If you have to transport fumigants, keep the container(s) locked in a metal box in your truck bed. If you transport large quantities on a regular basis, you may want to consider a security system. The applicator's manual lists the hazards associated with transporting aluminum phosphide. Be aware of these hazards and have a list of them with you in the truck. Your truck will need to display a placard providing information about aluminum phosphide. If you are carrying less than 46 pounds of fumigant, you may be eligible for a placarding exemption, such as exemption DOT E 11329 (http://hazmat.dot.gov).

Important Reminders
All fumigants are dangerous, and their use requires specific training. All fumigants are restricted-use pesticides for application by trained and certified pesticide applicators only. This publication is intended to assist applicators who meet these requirements. It is always advisable, however, to consider using the services of a professional commercial fumigator to reduce both risk and liability.

Use fumigants according to the directions on the label.
Follow all directions, precautions, and restrictions that are listed. Do not use fumigants on commodities or sites that are not listed on the label. The fumigant rates listed in this publication are recommended only for those fumigants registered with the Environmental Protection Agency and the pertinent state department of agriculture. If the label is cancelled or changed, the information contained herein is no longer recommended.



PRIMARY PPE FOR CHEMICAL MIXING & APPLICATION

Respiratory Protection

For personal protection against the vapors of phosphine at concentrations above the threshold limit, a respirator or other similar equipment for supplying uncontaminated air must be used. Respirators with a special canister for phosphine vapors will give protection up to 0.5 percent phosphine by volume in air (Kloos et al, 1966).

Above this concentration, air must be supplied by an air-line or self-contained breathing equipment. Appropriate detection equipment for measuring concentrations of phosphine in air should be used in conjunction with respiratory protective devices to ensure adequate protection.

General Precautions
Full precautionary instructions are supplied by the manufacturers of the proprietary materials used for generating phosphine. Some of the more important precautions are listed here.

1. Gloves should be worn when tablets or pellets are being dispensed by hand.

2. Respirators need not be worn when tablets or pellets are being dispensed under conditions where the operator does not breathe the vapors of phosphine. Under normal conditions, there is a delay in evolution of the fumigant from the formulations described in this manual. Respirators equipped with a canister designed for protection against phosphine (see above) or other appropriate respiratory equipment should always be on hand in case of emergency.

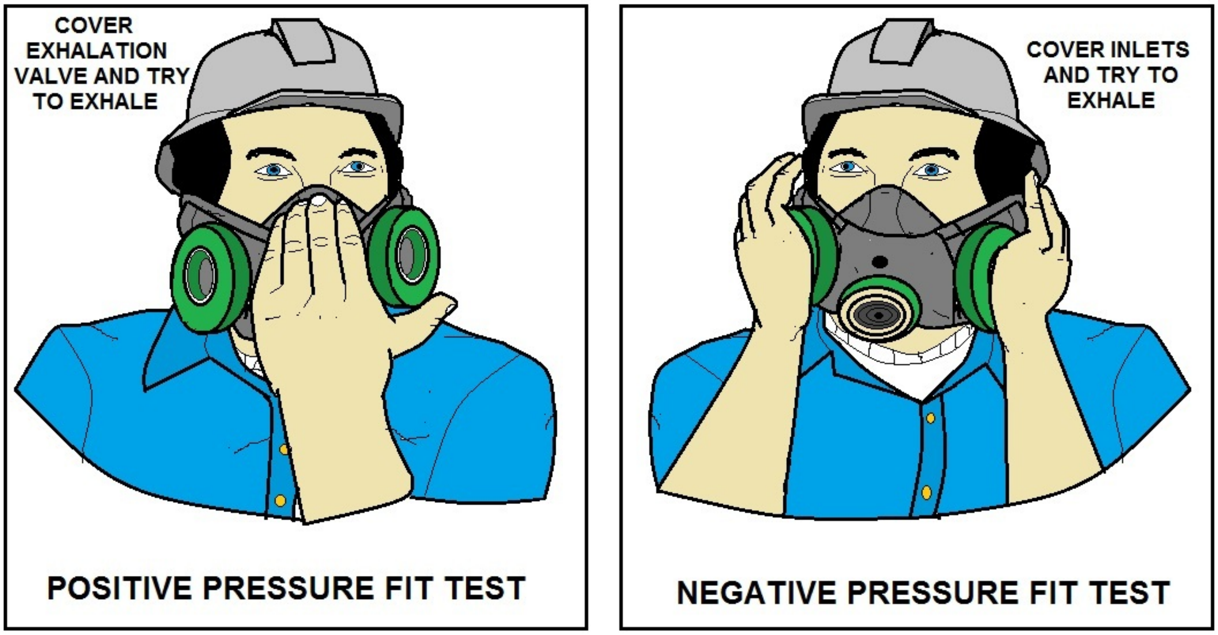
3. Odor of the fumigant cannot be relied upon as an indication of whether or not the operator is breathing poisonous concentrations. Detection equipment such as glass detector tubes or other detectors should be used to monitor concentrations of the gas and to determine when an area is free of fumigant after a treatment.

4. Do not smoke or touch food at any time during the application of this insecticide.

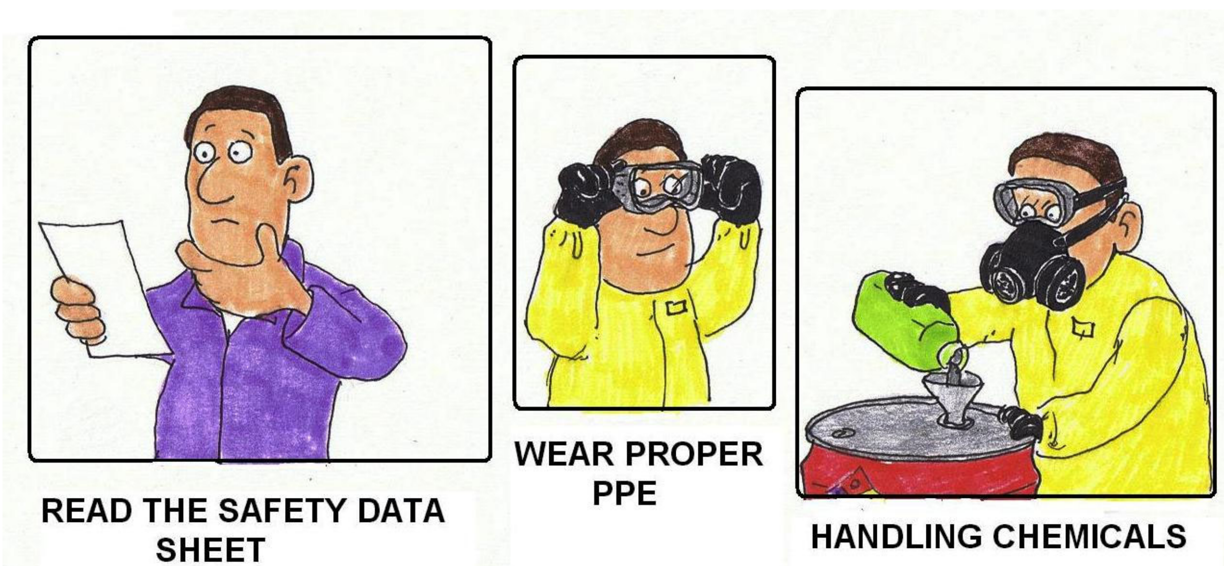
5. Any spaces adjoining silo bins or close to other structures undergoing treatment with phosphine should be kept continuously aired by leaving windows open or by providing artificial ventilation by means of fans or blowers.

6. All persons working, or likely to work, in any place near the fumigation area must be notified that fumigation is in progress. Warning notices should be posted to prevent exposure of employees or the public at large to the gas.

7. When the fumigation is completed and the grain is turned, or aeration of a structure is undertaken, full precautions must be undertaken to ensure that no person is exposed to residual vapors of the fumigant.



POSITIVE AND NEGATIVE PRESSURE FIT CHECKS



ALWAYS FOLLOW THE LABEL AND SDS

First Aid

Symptoms of Poisoning

According to the amount of phosphine inhaled, symptoms may occur immediately or several hours after exposure. Slight or mild poisoning may give a feeling of fatigue, ringing in the ears, nausea, pressure in the chest and uneasiness. All of these symptoms will normally disappear in fresh air. Greater quantities will quickly lead to general fatigue, nausea, gastrointestinal symptoms with vomiting, stomach ache, diarrhea, disturbance of equilibrium, strong pains in the chest and dyspnea (difficulty in breathing).

Very high concentrations rapidly result in strong dyspnea, cyanosis (bluish-purple skin color), agitation, ataxia (difficulty in walking or reaching), anoxia (subnormal blood oxygen content), unconsciousness and death. Death can be immediate or occur several days later due to edema and collapse of the lungs, paralysis of the respiratory system or edema of the brain. Disturbances of kidney and liver functions (hoematuria, proteinuria, uremia, jaundice) and cardiac arrhythmia may occur.

Advice to the Physician

The following measures are suggested by the manufacturer for use by the physician in accordance with his own judgment.

In its milder forms, symptoms of poisoning may take some time (up to 24 hours) to make their appearance, and the following measures are suggested:

1. Complete rest for one or two days, during which the patient is kept quiet and warm.
2. Should the patient suffer from vomiting or increased blood sugar; appropriate intravenous solutions should be administered. Treatment with oxygen breathing equipment is recommended as is the administration of cardiac and circulatory stimulants.

In cases of severe poisoning intensive care in a hospital is recommended:

1. Where pulmonary edema is observed, steroid therapy should be considered and close medical supervision is recommended. Blood transfusions may be necessary.
2. In case of manifest pulmonary edema, venesection should be performed under vein pressure control, and intravenous administration of glycosides (in case of haemoconcentration, venesection may result in shock). On progressive edema of the lungs, perform immediate incubation with constant removal of edema fluid and establishment of oxygen positive pressure respiration, as well as any measures required for shock treatment. In Case of kidney failure, extracorporeal hemodialysis is necessary. There is no specific antidote known for this poison.
3. Suicide may be attempted by taking solid phosphides by mouth. In such a case, empty the stomach by inducing vomiting and flush it with a dilute potassium permanganate solution or a solution of magnesium peroxide until the flushing liquid ceases to smell of carbide. Thereafter, administer medicinal charcoal.
4. Scientific research has shown that phosphine poisoning is not chronic; the action of phosphine is reversible and symptoms will disappear by themselves.

Health Effects & Toxicity

Fumigant pesticides also are among the most toxic chemicals used in agriculture. The U.S. EPA categorizes most fumigants as "highly acutely toxic"-- the agency's most extreme toxicity category.

Acute Fumigant Poisoning
Acute fumigant poisoning causes eye irritation, sore throat, headaches, nausea, vomiting, breathing difficulties and aggravated asthma, and neurological effects such as convulsions, dizziness, or tremors.

This course contains EPA's federal rule requirements. Please be aware that each state implements pesticide regulations that may be more stringent than EPA's regulations and these frequently are changed. Check with your state environmental/pesticide agency for more information.

Fumigant exposure also has long-lasting effects that include; many applicators will die from these…

Cancer
Several fumigants are known carcinogens, including methyl iodide, 1,3-Dichloropropene, and metam sodium; all of which are included in California's Proposition 65 carcinogen list.

Respiratory Damage
Exposure to fumigants can cause permanent respiratory damage. In lab animals chronically exposed to chloropicrin, researchers observed permanent damage to the bronchial tree, as well as lung cancer and tumors. The CDC classifies chloropicrin as a "lung damaging agent," noting that poisoning can cause a lethal pulmonary edema.

Neurological Effects
Methyl bromide and methyl iodide are both potent neurotoxins. Exposure to methyl bromide adversely affects cognitive function, physical coordination and muscular control (Extension Toxicology Network).

- Reproductive & developmental effects: Some fumigants are linked to elevated risk of miscarriage. In animal studies, fetal survival rate was significantly reduced from methyl iodide exposure.
- Immune system effects: Research shows that exposure to metam sodium and its breakdown product, methyl isothiocyanate, can weaken the human immune system.
- Endocrine Disruption: Fumigants are known to interfere hormones. In laboratory studies the fumigant metam sodium suppressed hormones that control ovulation and also increased stress hormones. Methyl iodide disrupts thyroid hormones critical for fetal development, resulting in increased miscarriage and developmental delays research shows.

Poisonings & Drift
The volatility of fumigants makes them inherently dangerous. Communities and farmworkers near agricultural fields face serious risks of acute pesticide poisoning from drifting fumigants. Fumigant drift has also been measured in air far from application sites, sometimes at levels above those considered “acceptable” for longer-term seasonal exposures by EPA or the California Department of Pesticide Regulation. Results from PANNA's Drift Catcher project in Sisquic, California showed that residents were exposed to levels of chloropicrin that exceeded California's acute level of concern for children.

Primary Fumigants: *Detailed and Explained*

Phosphine

Phosphine (IUPAC name: phosphane) is the compound with the chemical formula PH3. It is a colorless, flammable, toxic gas. Pure phosphine is odorless, but technical grade samples have a highly unpleasant odor like garlic or rotting fish, due to the presence of substituted phosphine and diphosphine (P_2H_4). With traces of P_2H_4 present, PH_3 is spontaneously flammable in air, burning with a luminous flame. Phosphines are also a group of organophosphorus compounds with the formula R_3P (R = organic derivative). Organophosphines are important in catalysts where they complex to various metal ions; complexes derived from a chiral phosphine can catalyze reactions to give chiral products.

Forms

Phosphine fumigants are sold in solid form, either as aluminum phosphide or magnesium phosphide. This publication focuses on aluminum phosphide that is sold under various brand names including Phostoxin, Phosfume, and Weevilcide. Aluminum phosphide can be used to eliminate insect infestations in a variety of commodities, including animal feed and feed ingredients, corn, cottonseed, grass seed, millet, oats, peanuts, pecans, popcorn, rye, sorghum, soybeans, triticale, and wheat. They can also be used for a variety of processed foods as long as the residue dust does not come in direct contact with the product. They can be used on some nonfood commodities including straw and hay, cotton, feathers, tobacco, dried plants and flowers, and seeds. The fumigant label contains a complete list of commodities that can be fumigated. Phosphine fumigants can be used in a variety of structures including grain bins and silos, rail cars, warehouses, and flat storage structures.

Aluminum phosphide is packaged as tablets about 5/8 inch in diameter, as pellets about 3/8 inch in diameter, or as granules in a sachet or small, porous bag. Tablets release about five times more phosphine gas than pellets release. At high temperatures, it may be safer to use tablets because they break down slower than pellets. If you are fumigating a raw agricultural commodity, you can use tablets or pellets, without removing the residue. For processed commodities, prepacs, ropes, or blankets, keep the residue within the packaging so it can be removed after the fumigation. Pest fumigation is a dangerous operation. It must be carried out by competent personnel or registered pest control companies that are in possession of the correct certification that allows them to perform pest fumigation operations.

Monitoring Done

There are a number of devices on the market for the measurement of phosphine gas. The devices range from glass tubes to electronic equipment. Knowledge of the use and limitations of such devices are part of the training program for fumigation workers. Registrants of phosphine products also serve as an additional source for information on these devices.

Make sure all employees know about the fumigation and are aware of potential safety hazards and emergency procedures. Make a list of the telephone numbers and addresses of the nearest fire department, rescue squad, hospital emergency room, and police department, and notify each agency of the fumigation ahead of time. Include on the list the names and telephone numbers of all appropriate personnel in charge.

Provide each agency with a copy of your fumigation management plan and any other information needed in case of an emergency.

This information should include the Safety Data Sheet (SDS) for the phosphine fumigant used and a copy of the label, including the applicator's manual. There may be local requirements in addition to those in the applicators manual. As you work your way through notifying the above agencies, you may learn of additional requirements.

Accidents involving aluminum phosphide are rare — but in case the worst happens, a well-informed emergency response team would have a greater chance of saving your life than one that has not been informed about the hazards of aluminum phosphide.

A certified applicator is someone who has passed a state exam. Individuals receiving specific instructions in documented training sessions are classified as trained applicators. One certified applicator and another trained person are the minimum personnel required when aluminum phosphide is applied. Two trained people can legally make the application, as long as they are under the direct supervision of the certified applicator. All should carry some form of communication device, such as a radio, a walkie-talkie, or a cellular phone. See the applicator's manual for requirements after the application.

You cannot follow label instructions without knowledge of the phosphine gas concentration during the fumigation process. One possible exception would be an isolated farm bin location on private property. The label requires that you keep a log showing phosphine gas concentration at key locations surrounding the structure.

The type of respiratory equipment used depends on the gas concentration. Furthermore, it makes sense to monitor the gas inside the structure (using extension hose from a safe outside location) to make sure an insect-lethal concentration of gas is present

Always follow label instructions and take steps to avoid exposure. If any exposures occur, be sure to follow the First Aid instructions on the product label carefully. For additional treatment advice, contact the Poison Control Center at 1-800-222-1222. If you wish to report a pesticide problem, please call 1-800-858-7378.

NOTE: When pesticides are used, it is the applicator's legal responsibility to read and follow directions on the product label. Not following label directions, even if they conflict with information provided herein, is a violation of federal law.

This publication contains pesticide recommendations that are subject to change at any time. These recommendations are provided only as a guide. It is always the pesticide applicator's responsibility, by law, to read and follow all current label directions for the specific pesticide being used. Due to constantly changing labels and product registration, some of the recommendations given in this writing may no longer be legal by the time you read them.

If any information in these recommendations disagrees with the label, the recommendation must be disregarded. No endorsement is intended for products mentioned, nor is criticism meant for products not mentioned. The author and Technical Learning College (TLC) assume no liability resulting from the use of these recommendations.

Chloropicrin

Some trade names for products containing chloropicrin include "Chlor-O-Pic," "Metapicrin" "Timberfume" and "Tri-Clor." A partial list of trade names for chloropicrin mixtures with methyl bromide includes "Tri-Con," "Terr-O-Gas," "Preplant Soil Fumigant" and "Pic-Brom." Chloropicrin mixtures with 1,3-Dichloropropene include "Telone C-17," "Tri-Form" and "Pic-Clor."

Regulatory Status

Chloropicrin is currently undergoing USEPA FIFRA reregistration. It is a Class I toxicity, Restricted Use Pesticide (RUP), labeled with the signal word "Danger". The U.S. Department of Transportation (DOT) proper shipping name is "Chloropicrin, 6.1, UN 1580, PGI, Poison Inhalation Hazard, Hazard Zone B." The Emergency Response Guide (ERG) number is 56. NFPA designations are 4-Health, 0-Fire, 3-Reactivity.

Chloropicrin is not listed under the EPA Clean Air Act, EPA Clean Water Act or the EPA Marine Pollutant List. A tolerance is not required for pre-plant soil fumigation uses of chloropicrin.

Description

Chloropicrin is a clear, colorless, oily liquid with a strong, sharp, highly irritating odor. It is a strong lachrymator. Chloropicrin has been used as an insecticide since 1917 and as a soil fumigant since 1920. The primary use today is for preplant soil fumigation to control soil borne fungi, diseases and nematodes. It also is used to treat wood poles and timbers for internal decay by fungi and insects; as a warning/clearing agent for sulfuryl fluoride (structural fumigant) and methyl bromide (soil and structural fumigant); and is also used in organic synthesis. For soil fumigation and wood treatment, chloropicrin is packaged in DOT 4BW240 steel cylinders and bulk tanks which may be pressurized. When used as a warning agent for methyl bromide, chloropicrin is packaged along with the methyl bromide in steel cylinders. When used as a structural fumigation warning agent for sulfuryl fluoride, chloropicrin is packaged in small plastic bottles in DOT approved overpacks.

Chloropicrin has a moderate vapor pressure (18.3 mmHg at 20 degrees C) and exists as a liquid at room temperature. Chloropicrin/methyl bromide mixtures will volatilize readily upon opening of the cylinder valve. Materials incompatible with chloropicrin are PVC, fiberglass, aluminum and magnesium and their alloys. Pest fumigation is a dangerous operation. It must be carried out by competent personnel or registered pest control companies that are in possession of the correct certification that allows them to perform pest fumigation operations.

Soil Fumigation

Chloropicrin is injected as a liquid into the soil approximately 6-10 inches below the surface, 14 days or more before crop planting. It kills target fungi within 48 hours of application. Chloropicrin also controls some root-destroying nematodes, soil insects, and other plant-limiting pests.

The importance of soil fumigation in the control of plant pathogens cannot be overstated. Even in agricultural soil with adequate nutrients, water and oxygen, plant growth and crop yields can decline over time due to increasing levels of pathogenic fungi and other pests. In the 1950s, before soil fumigation with chloropicrin, California strawberry growers resorted to applying 500 pounds/acre or more of nitrogen because of plummeting crop yields. The problem was not lack of soil nutrients--it was lack of healthy roots.

Environmentally, chloropicrin does not have a significant ozone depletion potential because it undergoes rapid breakdown in sunlight. It is metabolized in soil to carbon dioxide.

Under anaerobic/aquatic conditions, chloropicrin is converted to nitromethane within hours. In a plant metabolism study utilizing soil treated with radiolabeled chloropicrin, no chloropicrin or nitromethane was detected in any plant tissue or harvested produce.

How is chloropicrin used?
Extremely small quantities are used as part of the fumigation process, at concentrations that provide adequate warning without causing lingering odors or other adverse effects for home owners or the environment.

How is chloropicrin released into a home?
The fumigator carefully measures and pours the chloropicrin onto an absorbent material in one or more shallow pans. The pans are then placed near fans in the area where Vikane will be released. Air movement from the fans helps evaporate the chloropicrin and distribute it throughout the structure. Chloropicrin is released at least five to ten minutes before introducing Vikane to make sure is has sufficient time to act as a warning agent within the structure. You as the fumigator shall conduct a walk-through inspection to help confirm everyone is out of the structure prior to releasing chloropicrin. You as the fumigator shall also post warning signs around the structure to help prevent early or accidental re-entry. In addition, you as the fumigator shall use secondary locks on the entrances of your home that requires a special key to gain access to help ensure the structure remains free of people throughout the fumigation process.

Is the amount of chloropicrin used during the fumigation harmful to people?
Should I be concerned about it affecting my health? According to the product label, chloropicrin is used at very low application rate of 1 fluid ounce for every 10,000 to 15,000 cubic feet of fumigation space. This results in a controlled concentration of chloropicrin within the structure during the fumigation. After the fumigation period, your fumigator will aerate the Vikane and chloropicrin down to DPR accepted levels acceptable for you to re-enter the home. Once clearance has taken place, the amount of chloropicrin remaining in the home is at such a low level that homeowners need not to be concerned with any toxicological effects.

What should I do if I sense chloropicrin or experience symptoms after the fumigation?
Minute amounts of chloropicrin remaining in the structure may cause tearing, a scratchy throat or coughing. Although every effort is made to clear chloropicrin from you home, it may still be detectable at extremely low concentrations.

Even if you sense chloropicrin immediately following the fumigation of your home, a small amount of chloropicrin does not mean Vikane is still present. Vikane aerates from structures more rapidly, and fumigators use sensitive detection equipment to ensure that Vikane is cleared from you home prior to allowing re-occupancy. A few simple steps can assist in clearing any remaining chloropicrin from a home. A small amount of chloropicrin does not mean Vikane is present.

It is highly recommended that you as the fumigator <u>shall</u> complete the next steps: Retest to confirm is cleared from your home. <u>Open windows</u>. Operate fans of air-handling systems such as heat or air conditioning. Place additional fans near windows to create a directed air flow through the structure for efficient aeration.

Increase the temperature within the structure by turning off the air cooling compressors of air conditioners in the warmer months (operating the fan only) and using the central heating system in the cooler months. The above steps may require a few hours for the fumigator to complete. Leave the structure during this time if you continue to experience irritation from chloropicrin.

Hydrogen Cyanide (HCN)

Hydrogen cyanide is one of the most toxic of insect fumigants, many applicators and customers alike have died from this chemical. I know of one applicator that went to prison for not following the label instructions. I know another person whose son died from the effects of a poor treatment/ventilation method. The fact that Hydrogen cyanide is very soluble in water has considerable bearing on its use in practice. Thus, it may produce injury on moist materials, such as fruit and vegetables, because the solution of HCN in water is a dilute acid. Not only does this acid render these materials unpalatable and possibly hazardous for human consumption, but its action, by causing burning, wilting or discoloration, may make them unmarketable.

On the other hand, HCN has been widely used for fumigating dormant nursery stock that is sufficiently dry. It may be used for some living plants if they can be washed with water immediately after treatment to prevent burning by the acid.

HCN may be employed for fumigating many dry foodstuffs, grains and seeds. Although HCN is strongly sorbed by many materials, this action is usually reversible when they are dry, and, given time, all the fumigant vapors are desorbed. With many foodstuffs little, if any, chemical reaction occurs, and there is no detectable permanent residue. Because of the high degree of sorption at atmospheric pressure, HCN does not penetrate well into some materials. It WAS largely because of this that vacuum fumigation was adopted. Pest fumigation is a dangerous operation. It must be carried out by competent personnel or registered pest control companies that are in possession of the correct certification that allows them to perform pest fumigation operations.

Toxic
HCN is a powerful, quick acting poison. In humans and other warm-blooded animals, it induces asphyxiation by inhibiting the respiratory enzymes and renders tissues unable to absorb oxygen from the blood in the normal manner. The toxic action is reversible. In practice, this means that a person who is completely unconscious from the effects of cyanide, but whose heart is still beating, may still recover if suitable antidotes nod remedial measures are applied in time. HCN may be absorbed in toxic amounts through the unbroken skin (see below under "Precautions").

Toxicity to Insects
Among the commonly used fumigants, HCN is one of the most toxic to insects. It also has a rapid paralyzing effect on most species. This action is an important consideration in dealing with insects, because sub-lethal concentrations may bring about apparent death. After exposure to the fumigant, the reversible action of the poison may permit the insect to recover. This reaction has already been referred to as protective stupefaction (Lindgren, 1938). It is important from the practical point of view because it means that the maximum recommended concentration should be attained as quickly as possible during the application of the fumigant.

Flammability Limits
The flammability limits of HCN in air lie between 6 and 41 percent by volume. These limits are well above the normally recommended fumigation doses of up to 1.5 percent (16 g/m^3 or 16 oz/l 000 ft^3).

However, it must be pointed out that, at the point of release of the gas at the beginning of a fumigation, a concentration within these limits may exist for a short length of time.

If there is any flame (such as a pilot light) or sparks near temporary high concentrations, a serious fire or explosion could occur. In working with this fumigant, great care must be exercised to extinguish all flames and turn of all electric switches before a treatment begins.

Every few years there is a mass fumigant poisoning:

- In November 1999, drifting metam sodium poisoned an entire neighborhood in Earlmart, California, resulting in the evacuation of 150 people from their homes. One Earlimart resident recalled that she first noticed something was wrong when her infant son's eyes began to tear.
- In October 2003, a plume of chloropicrin drifted into the California community of Lamont after being applied to a nearby onion field. 150 residents were poisoned. Despite the widespread illness, application of the pesticide was continued the next day and 100 more people were affected.
- In October 2005, at least 300 people, including paramedics, were poisoned by chloropicrin when a strawberry field a quarter-mile away was fumigated in Salinas, California.

Side note: Over the years, I've seen several strange deaths related to fumigation and pesticide related treatments.

One example was a pregnant woman who had her home fumigated properly and lost her unborn child due to pesticide poisoning.

Several examples of cats being locked or lost in the home during fumigation. About half of these cats survived.

Always document everything and take digital photographs before, during and after the treatment and call the customer the next day and next week to follow-up on the progress.

All of this work is time consuming, however, if you get in to trouble or called in for an investigation or lawsuit, you need to be prepared to defend your work. It is best to send two-four trained applicators to these difficult treatments.

Pesticide Precautions

Respirators
Respirators fitted with the canister for acid gases will give protection against HCN and must be worn during all operations in which there is exposure to any concentration of this gas.

Absorption through Human Skin
HCN may be absorbed in toxic amounts through the unbroken skin; the amount is increased if the skin is moist. With modern fumigation techniques it is unnecessary for an operator to remain in a full fumigation concentration of HCN. The fumigant is either discharged from cylinders outside the structure or the gas is generated indoors by one of the methods described above. In the second type of operation, workers who apply granular calcium cyanide or HCN discs, or who initiate generation by dropping sodium cyanide into acid, are able to move away before a heavy concentration of fumigant builds up. During the aeration process it is usually possible to open some doors and windows from outside the structure and to start exhaust fans and blowers so that the full concentration of HCN in the air may be reduced before any person goes inside.

Although the industrial-type respirator canister will remove concentrations of HCN in air up to 2 percent by volume for a limited length of time, it is recommended, in order to avoid absorption of dangerous amounts through the skin, that persons wearing respirators do not remain for more than 5 minutes in concentrations of 0.75 percent or for more than 20 minutes in concentrations of 0.5 percent.

Symptoms of HCN Poisoning
Unless a person is immediately overcome by an overpowering concentration of HCN, a situation unlikely to be encountered in fumigation work when proper precautions are taken, there are preliminary symptoms which serve as a warning of poisoning. These symptoms are common to poisoning caused both by breathing HCN or by its absorption through the skin.

More common warning symptoms of HCN Poisoning are:

- irritation of the mucous membrane of the eyes, throat and upper respiratory tract;
- burning sensation on the tongue;
- metallic taste in the mouth
- feeling of pressure in the forehead;
- sharp pains in the head;
- giddiness and disturbed equilibrium;
- nausea and vomiting

If any of the foregoing, or related symptoms are experienced while a person is in the presence of HCN in any concentration, he should move immediately into fresh air, preferably where it is warm, and, if necessary, undergo the first aid treatment.

Although the poisonous action of HCN is rapid, a person may live for several hours after being completely overcome (Chen et al, 1935). Thus, even if there is some delay in the application of remedial treatments by the physician, it may still be possible to bring about the recovery of the patient.

Methyl Iodide
Methyl iodide is the proposed replacement for methyl bromide, is in fact more toxic than its predecessor. Pest fumigation is a dangerous operation. It must be carried out by competent personnel or registered pest control companies that are in possession of the correct certification that allows them to perform pest fumigation operations.

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Methyl Isocyanate (MIC)
Methyl isocyanate is an organic compound with the molecular formula C2H3NO, arranged as H3C-N=C=O. Synonyms are isocyanatomethane, methyl carbylamine, and MIC. Methyl isocyanate is an intermediate chemical in the production of carbamate pesticides (such as carbaryl, carbofuran, methomyl, and aldicarb). It has also been used in the production of rubbers and adhesives. As a highly toxic and irritating material, it is hazardous to human health, and was involved in the Bhopal disaster which killed nearly 8,000 people initially and approximately 17,000 people in total. Methyl isocyanate is an intermediate chemical in the production of carbamate pesticides (such as carbaryl, carbofuran, methomyl, and aldicarb). It has also been used in the production of rubbers and adhesives.

Methyl isocyanate (MIC) is extremely toxic. The threshold limit value set by the American Conference on Government Industrial Hygienist was 0.02 ppm. MIC can damage by inhalation, ingestion and contact in quantities as low as 0.4 ppm. Damage includes coughing, chest pain, dyspnea, and asthma, irritation of the eyes, nose and throat, as well as skin damage. Higher levels of exposure, over 21 ppm, can result in pulmonary or lung edema, emphysema and hemorrhages, bronchial pneumonia and death. Although the odor of methyl isocyanate cannot be detected at 5 ppm by most people, its potent lachrymal properties provide an excellent warning of its presence (at a concentration of 2–4 parts per million (ppm) subject's eyes are irritated, while at 21 ppm, subjects could not tolerate the presence of methyl isocyanate in air).

Proper care must be taken to store methyl isocyanate because of its ease of exothermically polymerizing (see Reactions) and its similar sensitivity to water. Only stainless steel or glass containers may be safely used; the MIC must be stored at temperatures below 40 °C (104 °F) and preferably at 4 °C (39 °F).

The toxic effect of the compound was apparent in the Bhopal disaster, when around 42,000 kilograms (93,000 lb.) of methyl isocyanate and other gases were released from the underground reservoirs of Union Carbide India Limited (UCIL) factory, over a populated area on December 3, 1984, immediately killing thousands and leading to the deaths of tens of thousands in subsequent weeks and months.

Iodoform
Iodoform is the organoiodine compound with the formula CHI3. A pale yellow, crystalline, volatile substance, it has a penetrating odor (in older chemistry texts, the smell is sometimes referred to as the smell of hospitals) and, analogous to chloroform, sweetish taste. It is occasionally used as a disinfectant. It is sometimes also referred to as carbon triiodide (which is not strictly correct, as this compound also contains hydrogen) or methyl triiodide (which is somewhat ambiguous as that name could also refer to the methylated triiodide ion, CH_3I_3. Pest fumigation is a dangerous operation. It must be carried out by competent personnel or registered pest control companies that are in possession of the correct certification that allows them to perform pest fumigation operations. The compound finds small scale use as a disinfectant. Around the beginning of the 20th century it was used in medicine as a healing and antiseptic dressing for wounds and sores, although this use is now superseded by superior antiseptics.

Adolf Hitler's mother, Klara Hitler, died of Iodoform poisoning brought on by her treatment for breast cancer. It is the active ingredient in many ear powders for dogs and cats, to prevent infection and facilitate removal of ear hair, along with zinc oxide and propanoic acid.

Formaldehyde
Formaldehyde is an organic compound with the formula CH2O. It is the simplest aldehyde, hence its systematic name methanal. Formaldehyde is a colorless gas with a characteristic pungent odor. It is an important precursor to many other chemical compounds, especially for polymers. In 2005, annual world production of formaldehyde was estimated to be 23 million tons (50 billion pounds). Commercial solutions of formaldehyde in water, commonly called formalin, were formerly used as disinfectants and for preservation of biological specimens. In view of its widespread use, toxicity and volatility, exposure to formaldehyde is a significant consideration for human health. On 10 June 2011, the US National Toxicology Program has described formaldehyde as "known to be a human carcinogen".

American Cockroaches Invincible
American" adult cockroaches can survive exposure to various forms of fumigation, including formaldehyde fumigation that is carried out at double strength and for four times as long as is recommended for disinfection of rooms. It is further reported that vaccinia virus ingested prior to the fumigation survives in the cockroach gut and may be excreted up to 5 days later. Since cockroaches are ubiquitous and are to be found in most hospitals, laboratories and animal houses, these findings should be considered whenever fumigation is called for.

Always follow label instructions and take steps to avoid exposure. If any exposures occur, be sure to follow the First Aid instructions on the product label carefully. For additional treatment advice, contact the Poison Control Center at 1-800-222-1222. If you wish to report a pesticide problem, please call 1-800-858-7378.

NOTE: When pesticides are used, it is the applicator's legal responsibility to read and follow directions on the product label. Not following label directions, even if they conflict with information provided herein, is a violation of federal law. This publication contains pesticide recommendations that are subject to change at any time.

These recommendations are provided only as a guide. It is always the pesticide applicator's responsibility, by law, to read and follow all current label directions for the specific pesticide being used.

Due to constantly changing labels and product registration, some of the recommendations given in this writing may no longer be legal by the time you read them. If any information in these recommendations disagrees with the label, the recommendation must be disregarded. No endorsement is intended for products mentioned, nor is criticism meant for products not mentioned. The author and Technical Learning College (TLC) assume no liability resulting from the use of these recommendations.

Sulfuryl Fluoride

Sulfuryl fluoride has the ability to kill pests at any stage of their lives, including eggs. It does not harm the ozone layer and it is not associated with the dangers of phosphine. Sulfuryl fluoride is used widely as a pest fumigant to control dry wood termites that thrive in warm climates. It is also effective for the eradication of bark beetles, powder post beetles, rodents and bed bugs.

Sulfuryl fluoride is the inorganic compound with the formula SO_2F_2. This easily condensed gas has properties more similar to sulfur hexafluoride than sulfuryl chloride, being resistant to hydrolysis even up to 150 °C. So inert is this material that suspended molten "sodium metal retains its shiny metallic appearance." Use of SO_2F_2 as a fumigant has increased rapidly as it replaces methyl bromide, now being phased out because of harm to the ozone layer, and as an alternative to the risks of phosphine.

Originally developed by the Dow Chemical Company, sulfuryl fluoride is in widespread use as a structural fumigant insecticide to control drywood termites, particularly in warm-weather portions of the southwestern and southeastern United States and in Hawaii. Less commonly, it can also be used to control rodents, powderpost beetles, bark beetles, and bedbugs.

Sulfuryl fluoride is currently marketed by three distinct manufacturers, under four different brand names. Vikane (Dow) (EPA Reg. No. 62719- 4-ZA) has been commercially available since the early 1960s, with Zythor (marketed by competitor Ensystex of North Carolina) (EPA Reg. No. 81824- 1-AA) being more recently introduced gradually as its use is approved by individual states (in Florida circa 2004, but not in California until October 2006, for example). Dow recently has begun marketing sulfuryl fluoride as a post-harvest fumigant for dry fruits, nuts, and grains under the trade name ProFume (EPA Reg. No. 62719- 376-AA). Most recently Drexel Chemical Company has registered Master Fume (EPA Reg. No. 19713-596-AA) for the structural market, competing against Vikane and Zythor.

Pest fumigation is a dangerous operation. It must be carried out by competent personnel or registered pest control companies that are in possession of the correct certification that allows them to perform pest fumigation operations.

This course contains EPA's federal rule requirements. Please be aware that each state implements pesticide regulations that may be more stringent than EPA's regulations and these frequently are changed. Check with your state environmental/pesticide agency for more information.

Spraying Chemicals

After bait stations are placed, one will see ants trailing to and from these bait stations. Do not spray or disturb the ants or bait stations. Ants must be allowed to carry the bait back into their nest where the active ingredient in the bait will eliminate the colony.

The most commonly used method for controlling carpenter ants is treating the perimeter of a home with a dust or spray. There are several products available for this type of application, but **Suspend SC**, **Talstar Concentrate** and **Cynoff WP** are the best. When used in accordance with their labels they work well.

Window sills are easy ant and termite entry points. Scorpions are super hard to kill; you have to drown them to kill them but they are great money makers. If the landscaping has rocks or granite, the home will be a magnet for scorpions. I had a call one time and the customer saw a scorpion on the bed, I turned the bed over and found hundreds. I made a customer for life but I had to do a lot of work including screening the entire houses. I think the only thing worse than scorpions are bed-bugs.

Pesticide Adsorption Sub-Section

Parts of this section come from Ohio and Missouri State University Extensions.

Adsorption Process

The adsorption process binds pesticides to soil particles, similar to iron filings or paper clips sticking to a magnet. Adsorption often occurs because of the attraction between a chemical and soil particles. Positively charged pesticide molecules, for example, are attracted to and can bind to negatively charged clay particles. Many soil factors influence pesticide adsorption. Soils high in organic matter or clay are more adsorptive than coarse, sandy soils, in part because a clay or organic soil has more particle surface area, or more sites onto which pesticides can bind. Moisture also affects adsorption. Wet soils tend to adsorb less pesticide than dry soils because water molecules compete with the pesticide for the binding sites.

Pesticides vary in their adsorption to soil particles. Some pesticides such as paraquat and glyphosate bind very tightly, while others bind only weakly and are readily desorbed or released back into the soil solution.

As soon as the pesticide is applied into the environment it is affected by a number of physical, chemical or biological processes which then affect how persistent it might be or whether or not the pesticide moves. These processes are generally beneficial. On occasions some practices might be perceived as detrimental. For example, the watering in of a surface applied herbicide makes it work better because the herbicide is root absorbed. Therefore, there is little or no runoff or leaching. In addition, the degradation of a soil applied pesticide occurs through several mechanisms which reduce the toxicity over time.

As we then look at those processes that impact the pesticide, once introduced into the environment, we can divide them in to three major categories:

- **Adsorption**
- **Transfer**
- **Degradation**

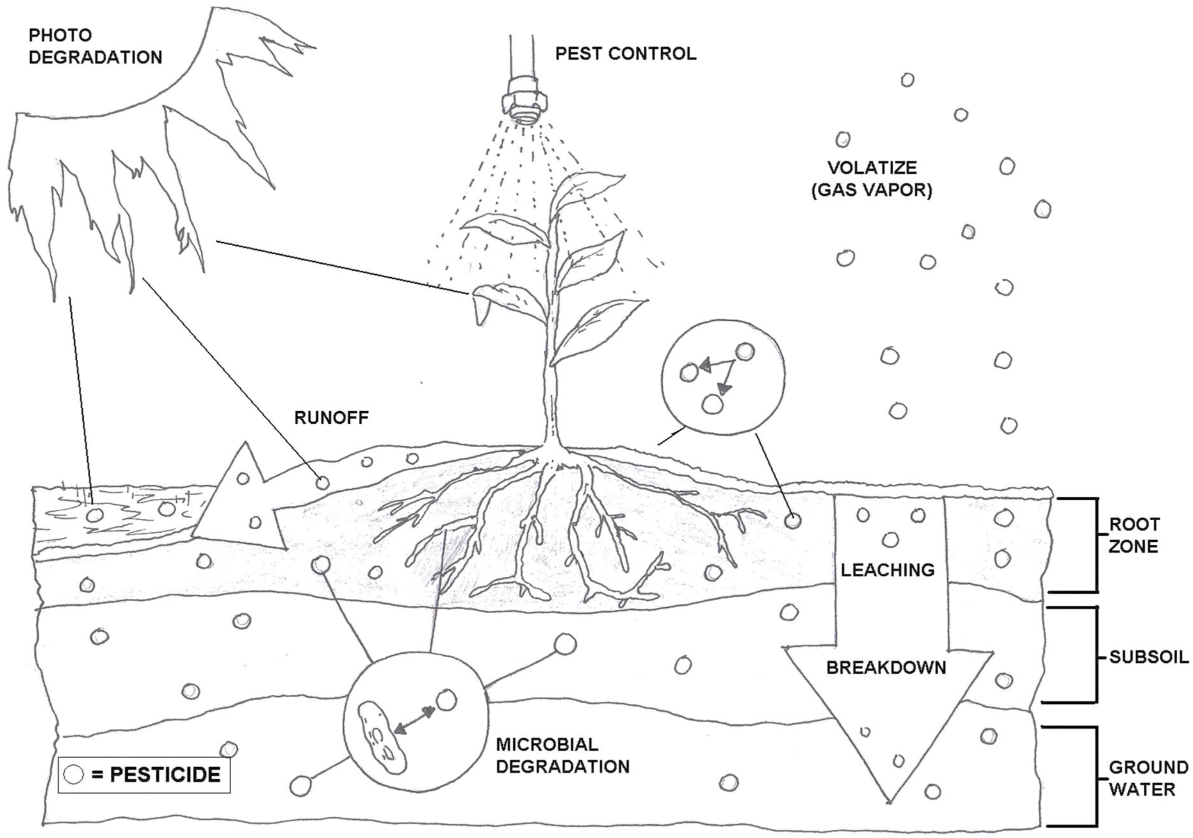
Adsorption

Adsorption is the binding of the pesticide to the mineral components of the soil or organic matter, which is abundant in turf. In turf, organic matter includes, in many circumstances, a thatch layer. In other pesticide application circumstances there is not a thatch layer like we have in a turf system. This layer makes the turf system quite unique with regard to the buffering capacity of the system to those materials introduced into it. There's also a transfer process (where pesticides can actually move in the environment) and, finally, a degradation process that removes pesticides (through degradation). Adsorption as a process is pretty straight forward and occurs when a chemical binds to organic or mineral matter in a way that it cannot be dislodged by water.

Transfer processes include such things as volatilization, runoff, leaching, up-take by various flora and fauna (including the turf), and removal of the treated vegetation. With turf grass, we commonly look at the transfer process in terms of removal (movement of pesticides) from the turf due to the mowing process (the collection of clippings and their transfer to some other location). In some circumstances detrimental effects can occur.

For example, if herbicides are applied to turf and then the clippings are removed soon after application and are applied to garden plants as mulch, the herbicide may volatilize from those clippings and certain sensitive plants could be injured.

Common sense should dictate that garden vegetables like tomatoes, peppers, and other vulnerable vegetables should not be mulched with grass clippings taken where herbicides have recently been applied.

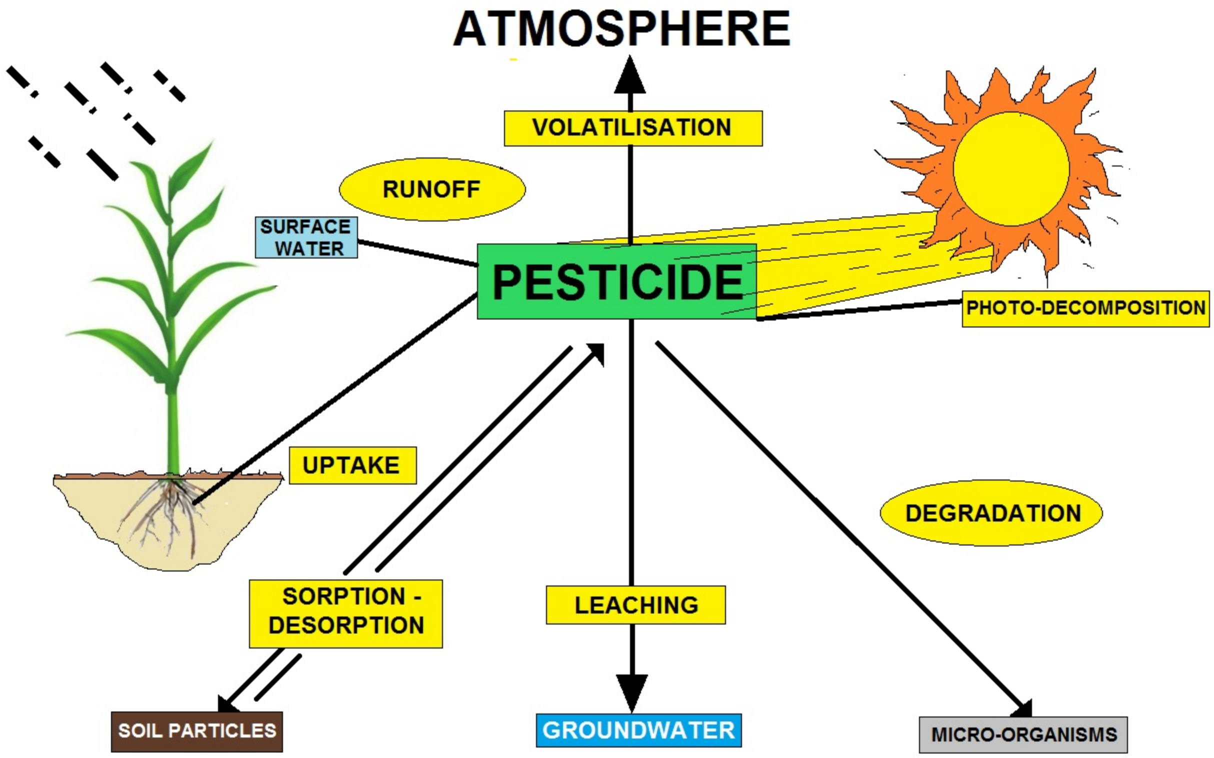


SOIL DEGRADATION FROM PESTICIDES DIAGRAM

Reduced Pest Control
One problem resulting from pesticide adsorption is reduced pest control. For example, weeds may not be controlled if a herbicide is held tightly to soil particles and cannot be taken up by the roots of the target weeds. Some pesticide labels recommend higher application rates when the chemical is applied to adsorptive soils.

Plant injury can be another problem resulting from adsorption of pesticides to soil particles. Injury can result when a pesticide used for one crop is later released from the soil particles in amounts great enough to cause injury to a sensitive rotational crop. This pesticide “carry-over” can also lead to the presence of illegal residues on rotational food or feed crops. Adsorption is particularly important because it influences whether other processes are able to affect pesticides.

The Pesticide Fate Processes



PESTICIDE FATE DIAGRAM

Pesticide Adsorption
The adsorption process binds pesticides to soil particles and/or plant parts, similar to iron filings or paper clips sticking to a magnet. Adsorption often occurs because of the attraction between a chemical and soil or organic particles. For example, positively charged pesticide molecules are attracted to and can bind to negatively charged clay particles and plant debris.

Many soil factors influence pesticide adsorption. Soils high in organic matter or clay are more adsorptive than coarse sandy soils. This occurs, in part, because a clay or organic soil has a greater particle surface area or number of sites onto which pesticides can bind. Soil moisture also influences adsorption. Wet soils tend to adsorb less pesticide than dry soils because water molecules compete with the pesticide for the binding sites on soil particles. Pesticides may adsorb onto plant materials such as litter in no-till or minimum-till fields, the bark of trees, or thatch in turf. These organic layers may prohibit pesticide movement to target areas deeper in the soil. Pesticides vary in their tendency to adsorb to soil particles. Some pesticides, such as paraquat and glyphosate, bind very tightly, while others bind only weakly and are readily desorbed or released back into the soil solution. Adsorption is particularly important because it influences whether other processes can affect pesticides.

Pre-emergence Herbicides

Pre-emergence herbicides can be useful chemical tools for you as you attempt to manage weeds before they can compete for valuable space in your turf. Unfortunately, the level of control you desire does not always happen. There are a host of possible reasons for not getting the control that you want; but, by far and away, the most probable reason is improper timing of application — usually that they are not applied soon enough.

Chemical Barrier

You should have your pre-emergence herbicides on the ground and activated prior to the initiation of weed seed germination. Activation is important because you want to have an "active" chemical barrier present in the soil solution when the target weed seeds imbibe water. You can insure activation easily by irrigating immediately after herbicide activation. Be sure to irrigate at least equivalent to a half inch of rainfall.

Actually, if you plan to use sprayed formulations of pre-emergence herbicides, a good way to insure activation is to apply them when it is raining. In circumstances where irrigation is not available and you must depend on rainfall for activation, you should apply pre-emergence herbicides earlier than you might when you could irrigate, to insure there is ample time for rainfall to occur.

A variety of factors affect the performance of pre-emergence herbicides. These include timing of application in relation to weed seed germination, soil type, environmental conditions (primarily temperature and rainfall), target weed species and biotype. Ideally, pre-emergence herbicides should be applied just before weed seed germination begins. Applying too early may result in reduced control or no control due to leaching and/or normal herbicide degradation.

However, there is a good deal of research that indicates pre-emergence summer annual grass control applications may be made as early as January. The reason this works is that during cool weather, the rate of herbicide degradation is slow and most of the pre-emergence grass herbicides do not leach readily.
Pre-emergence herbicides must be in place and activated before weed seed germination begins. Activation of pre-emergence herbicides requires 0.25 to 0.5 inch of rainfall or irrigation. For optimum performance, rainfall or irrigation should occur within 24 hours of application to move the herbicides into the upper layer of the soil. The critical period between application and activation by rainfall or irrigation varies with herbicide, rate, and environmental conditions.

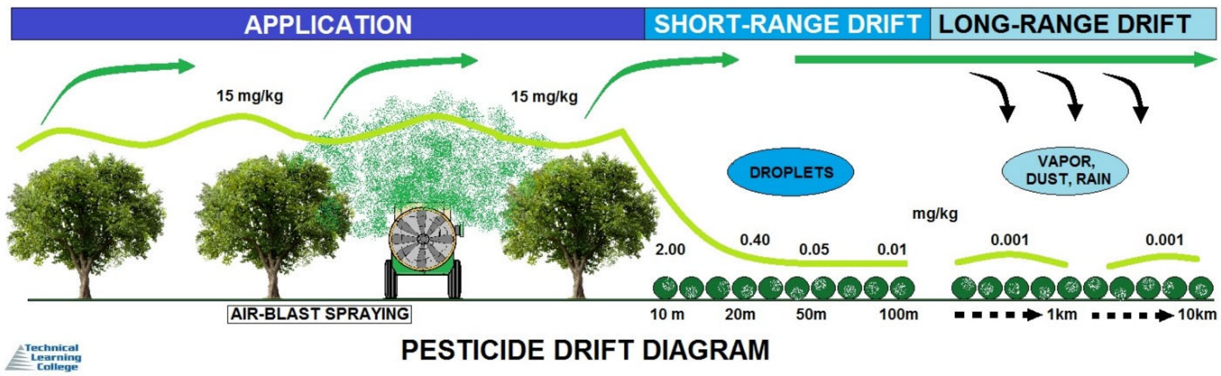
Crabgrass germinates in the spring (late March-April) when soil temperature at the 4-inch depth reaches 53 degrees Fahrenheit. Alternating wet and dry conditions at the soil surface as well as light encourage crabgrass germination.

Sequential or Repeat Applications of Pre-emergence Herbicides

In warm weather, herbicides begin to degrade soon after application eventually reaching a level at which weed seed germination can occur. Pre-emergence herbicides will degrade to the point of ineffectiveness from 6 to 16 weeks after application. For this reason, repeat or sequential applications are needed for full season control. Make sequential applications 60 days after the initial treatment.

Pesticide Transfer

Pesticide transfer is sometimes essential for pest control. For example, for certain pre-emergence herbicides to be effective, they must move within the soil to reach the germinating seeds. Too much movement, however, can move a pesticide away from the target pest. This can lead to reduced pest control, contamination of surface water and groundwater, and injury of non-target species, including humans. Five ways that pesticides can be transferred are through volatilization, runoff, leaching, absorption and crop removal.



PESTICIDE DRIFT DIAGRAM

Volatilization

Volatilization is the conversion of a solid or liquid into a gas. Once volatilized, a pesticide can move in air currents away from the treated surface. Vapor pressure is an important factor in determining whether a pesticide will volatilize. The higher the vapor pressure, the more volatile the pesticide. Volatilization occurs when a pesticide partitions from the solid or aqueous phase to the gas phase. Once volatilized, a pesticide may diffuse into the atmosphere and either be destroyed or continue as an environmental risk. When mixing disturbs a soil contaminated by a pesticide or other organic compound, a 30 percent or greater loss of the soil contaminant through volatilization is not unusual.

Thermophilic Temperatures

Volatilization of a pesticide is highly temperature dependent; thermophilic temperatures typically increase pesticide losses. The tendency for a pesticide to volatilize also depends upon its size, structure, and function. Moisture also affects volatilization rates.

Water may physically impede the flow of a gas phase pesticide by obstructing the pores through which gases travel.

Water may also promote volatilization by liberating weakly adsorbed pesticides. Environmental factors tend to increase volatilization. They include high temperature, low relative humidity, and air movement. A pesticide tightly adsorbed to soil particles is less likely to volatilize; soil conditions such as texture, organic matter content, and moisture can thus influence pesticide volatilization.

Volatilization can result in reduced control of the target pest because less pesticide remains at the target site. Vapor drift, the movement of pesticide vapors or gases in the atmosphere, can lead to injury of non-target species. Herbicide vapors in particular can injure non-target plants.

To reduce pesticide volatilization, avoid applying volatile pesticides when conditions are unfavorable, such as very hot, dry days or when the soils are wet. Labels often provide warnings if there is a volatility hazard under certain conditions.

Labels for volatile pesticides may suggest adding the pesticide to the soil by tillage or irrigation during or shortly after application. This helps to reduce volatilization by reducing the amount of exposed pesticide on the soil surface. Low-volatile formulations are also available for some pesticides.

Runoff
Runoff is movement of water over a sloping surface. Runoff occurs when water is applied faster than it can enter the soil. Pesticides can be carried in the water itself or bound to eroding soil particles. The severity of pesticide runoff depends on the slope or grade of an area; the erodibility, texture and moisture content of the soil; and the amount and timing of rainfall and irrigation. Pesticide runoff usually is greatest when a heavy or sustained rain follows soon after an application. Over-irrigation can lead to excess surface water; it also can lead to pesticide runoff, especially when an irrigation system is used to apply a pesticide.

Vegetation or crop residue tends to slow the movement of runoff water. Certain physical and chemical properties of the pesticide, such as how quickly it is absorbed by plants or how tightly it is bound to plant tissue or soil, are also important.

Herbicide runoff can cause direct injury to non-target plants. Insecticide and nematicide runoff into surface waters such as streams and ponds can be particularly harmful to aquatic organisms. Pesticide runoff also can lead to groundwater contamination and can cause injury to crops, livestock or humans if the contaminated water is used downstream.

Practices to reduce pesticide runoff include monitoring of weather conditions, careful application of irrigation water, using a spray mix additive to enhance pesticide retention on foliage, and incorporating the pesticide into the soil. Reduced-tillage cropping systems and surface grading, in addition to contour planting and strip cropping of untreated vegetation, can slow the movement of runoff water and help keep it out of wells, sinkholes, water bodies and other sensitive areas.

Leaching
Leaching is the movement of pesticides through the soil rather than over the surface. Leaching depends, in part, on the pesticide's chemical and physical properties. For example, a pesticide held strongly to soil particles by adsorption is less likely to leach. Another factor is solubility. A pesticide that dissolves in water can move with water in the soil. The persistence, or longevity, of a pesticide also influences the likelihood of leaching. A pesticide that is rapidly broken down by a degradation process is less likely to leach because it may remain in the soil only a short time.

Water-soluble pesticides have a tendency to be “rinsed away” through a process called leaching, that is, the movement of a chemical within percolating water. Typically, leaching is of concern when the pesticide moves into groundwater or another location, posing an increased risk to humans and/or the environment. Many pesticides are not highly soluble in water, readily adsorbing onto the organic matter fraction. For this reason, use of composts in agricultural soils tends to reduce the threat of pesticide leaching losses.

Soil factors that influence leaching include texture and organic matter, in part because of their effect on pesticide adsorption. Soil permeability (how readily water moves through the soil) is also important. The more permeable a soil, the greater potential for pesticide leaching. A sandy soil is much more permeable than a clay.

The method and rate of application, the use of tillage systems that modify soil conditions, and the amount and timing of water a treated area receives after application can also influence pesticide leaching. Typically, the closer the time of application to a heavy or sustained rainfall, the greater the likelihood that some pesticide leaching will occur.
A certain amount of pesticide leaching may be essential for control of a target pest. Too much leaching, however, can lead to reduced pest control, injury of nontarget species and groundwater contamination.

Monitoring weather conditions and the amount and timing of irrigation can help minimize pesticide leaching. Careful pesticide selection is important because those pesticides that are not readily adsorbed, not rapidly degraded, and highly water soluble are the most likely to leach. Labels must be read carefully for instructions on the rates, timing and methods of application. The label may also advise against using the pesticide when certain soil, geologic or climatic conditions are present.

Pesticides can leach through the soil to groundwater from storage, mixing, equipment cleaning and disposal areas. Under certain conditions, some pesticides can leach to groundwater from normal applications. The section "Pesticides and water quality" provides further discussion on groundwater and safe handling practices to prevent contamination.

Absorption or Uptake
Absorption or uptake is the movement of pesticides into plants and animals. Absorption of pesticides by target and non-target organisms is influenced by environmental conditions and by the chemical and physical properties of the pesticide and the soil. Once absorbed by plants, pesticides may be broken down or they may remain in the plant until tissue decay or harvest.

Crop Removal
Crop removal transfers pesticides and their breakdown products from the treatment site. Most harvested food commodities are subjected to washing and processing procedures that remove or degrade much of the remaining pesticide residue. While we typically associate harvesting with food and feed products, it is easy to forget that pesticides potentially can be transferred during such operations as tree and shrub pruning and turf grass mowing.

Pesticide Degradation
Pesticide degradation, or the breakdown of pesticides, usually is beneficial. Pesticide-destroying reactions change most pesticide residues in the environment to nontoxic or harmless compounds. However, degradation is detrimental when a pesticide is destroyed before the target pest has been controlled.

Biological Degradation
Microorganisms have developed many enzymes that can break down natural compounds. Modern scientists, though, have created pesticides with chemical structures not found in nature. These unique structures are often responsible for a pesticide's effectiveness and also explain why pesticides can persist in the environment. A pesticide's environmental persistence largely depends on its chemical structure and on the presence of unusual functional groups, which are large sub-structures within the pesticide molecule.

The chemical structure helps determine its water solubility and consequently, its bioavailability, since microbes more readily assimilate water-soluble compounds.

When a pesticide's functional groups are attached with weak or labile bonds, it can degrade more rapidly. Many modern pesticides have such bonds designed into them to avoid problems of extended persistence. Adding water may break many labile bonds. This process is called hydrolysis and the enzymes that promote hydrolysis are termed hydrolytic. Malathion is an example of an insecticide containing many such labile bonds that may be broken using hydrolytic enzymes (for example, esterase and phosphatase).

Hydrolytic Degradation
Other pesticides capable of hydrolytic degradation are: carbamate pesticides, urea derivatives, pyrethroids, diazinon, dicamba, dichloropicolinic acid, dimethoate, phenylalkanoic ester, dimethoate, phenylalkanoic pyrazon, atrazine, linuron, propanil, chlorpyrifos, and 2,4-D.Two other classes of enzymes, mono- and di-oxygenases, are also commonly associated with pesticide degradation. These enzymes introduce one or two oxygen atoms, respectively, into the structure of a pesticide. This oxidation process often makes the pesticide more amenable to further degradation by increasing its water solubility, thereby increasing its bioavailability. Degradation may begin at the extracellular level and then proceed further at the intracellular level.

Extracellular Decomposition
Many of the same enzymes microorganisms use to break down cellulose, hemicellulose, and lignin—the primary natural compounds in most plant material—may also degrade pesticides during composting. The large polymeric structure of these natural compounds prevents their passage into the microorganism for consumption. To deal with this problem, microorganisms begin breaking down chemicals outside their "body," or extracellularly. They excrete enzymes out of their cells that react with the bonds in cellulose, hemicellulose, and/or lignin, breaking them down into smaller components. The shortened polymers can then be subjected to further degradation.

Extracellular Enzymes
Extracellular enzymes can have very low "specificity," working like a key that fits different locks. They can, therefore, react with many different chemicals. If the enzyme finds a pesticide before reaching its "intended" substrate (for example, cellulose, hemicellulose, lignin), it may react with it, changing the pesticide into a possibly less toxic and less hazardous form. Such co-metabolism appears to play a significant role in degrading pesticides found in compost and soil. Fungi are the source of most extracellular enzymes. Some fungi often associated with compost and soil organic matter are in the genera Trichoderma, Gliocladium, Penicillium, and Phanerochaete. Fungi grow through the development of hyphae (long strings of cells) that extend throughout compost or soil organic matter.

The hyphae release extracellular enzymes, which break down the pesticide and allow it to pass into the cells. This allows the production of additional hyphae and/or energy. Although fungi are present in compost feedstock, they contribute more to composting in its later stages. As bacteria exhaust the easily degraded organic matter from the feedstock, fungi then begin to degrade the more recalcitrant polymeric organic matter.

Intracellular Decomposition

After extracellular enzymes begin breaking down a pesticide or if it is otherwise bioavailable, a pesticide may enter the cell of a microorganism. To pass into a cell efficiently, the pesticide must be dissolved in water. Generally pesticides containing more oxygen, nitrogen, and sulfur tend to be more water soluble due to hydrogen bonding. Once inside a cell, a pesticide may undergo varying degrees of degradation. Mineralization reduces the pesticide to carbon dioxide, water, and other inorganic components. Typically, it accounts for only a small portion of the "disappearance" of a pesticide through composting.

Adsorption

Water-insoluble pesticides tend to adsorb onto and within organic matter, making them even less bioavailable. The chemistry of the functional groups in the pesticide and the organic matter dictates the strength of this pesticide-organic matter interaction. Adsorbed pesticides are generally much more resistant to breakdown than water-soluble pesticides. This is because the latter have a much greater chance of contact with pesticide-degrading microorganisms as described above. Consequently, highly adsorbed pesticides are not considered bioavailable, enabling them to persist for months or even years. However, when a pesticide is adsorbed to organic matter that eventually decomposes, it may once again become bioavailable.

Additional factors can make adsorption a likely outcome for even water-soluble pesticides. For example, many pesticides contain acidic and nitrogen-containing functional groups that can adsorb due to the presence of a negative or positive charge, respectively. A negatively charged pesticide will adsorb to positively charged functional groups on organic matter, while positively charged pesticides will adsorb to negatively charged functional groups on organic matter and clays.

Three types of pesticide degradation are microbial, chemical, and photodegradation.

Microbial Degradation

Microbial degradation is the breakdown of pesticides by fungi, bacteria, and other microorganisms that use pesticides as a food source. Most microbial degradation of pesticides occurs in the soil. Soil conditions such as moisture, temperature, aeration, pH, and the amount of organic matter affect the rate of microbial degradation because of their direct influence on microbial growth and activity.

The frequency of pesticide application also is a factor that can influence microbial degradation. Rapid microbial degradation is more likely when the same pesticide is used repeatedly in a field. Repeated applications can actually stimulate the buildup of organisms that are effective in degrading the chemical.

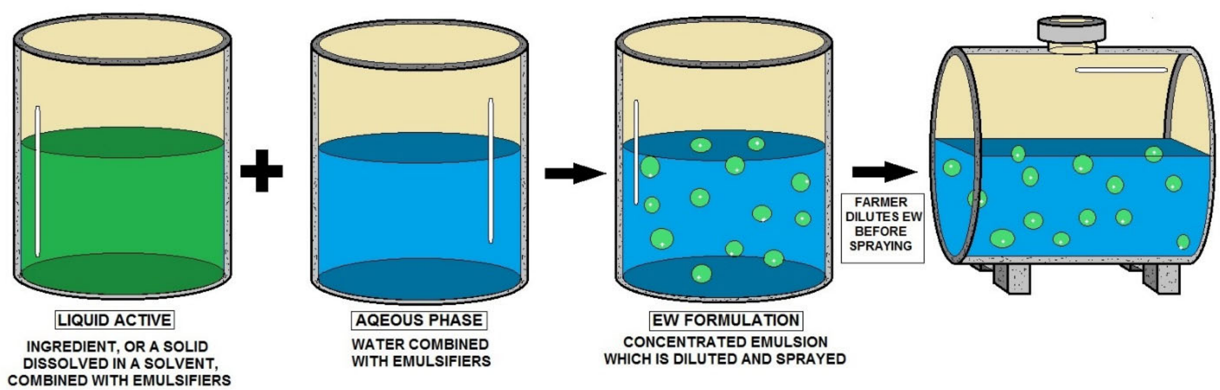
As the population of these organisms increases, degradation accelerates and the amount of pesticide available to control the pest is reduced. In extreme cases, accelerated microbial degradation has led to certain products being removed from the marketplace. Microorganisms greatly reduce the effectiveness of these chemicals soon after application.

The possibility of very rapid pesticide breakdown is reduced by using pesticides only when necessary and by avoiding repeated applications of the same chemical. Alternating between different classes, groups or formulations of pesticides can minimize the potential for microbial degradation problems as well as pest resistance.

Chemical Degradation
Chemical degradation is the breakdown of pesticides by processes that do not involve living organisms. Temperature, moisture, pH and adsorption, in addition to the chemical and physical properties of the pesticide, determine which chemical reactions take place and how quickly they occur. One of the most common pesticide degradation reactions is hydrolysis, a breakdown process in which the pesticide reacts with water. Many organophosphate and carbamate insecticides are particularly susceptible to hydrolysis under alkaline conditions. Some are actually broken down within a matter of hours when mixed with alkaline water.

Product labels may warn against mixing a pesticide with certain fertilizers, other pesticides or water with specific characteristics. Following these precautions can help prevent pesticide degradation and potential incompatibility problems. In some situations, buffers or other additives may be available to modify spray mix conditions and prevent or reduce degradation. Pesticide degradation and possible corrosion of application equipment can be avoided by not allowing a spray mix to remain in a tank for a long period of time.

Photodegradation
Photodegradation is the breakdown of pesticides by light, particularly sunlight. Photodegradation can destroy pesticides on foliage, on the surface of the soil, and even in the air. Factors that influence pesticide photodegradation include the intensity of the sunlight, properties of the application site, the application method and the properties of the pesticide. Pesticide losses from photodegradation can be reduced by adding the pesticide to the soil during or immediately after application.



CONCENTRATED AQUEOUS EMULSION PROCESS

Environmental Effects

Effects on Non-target Species

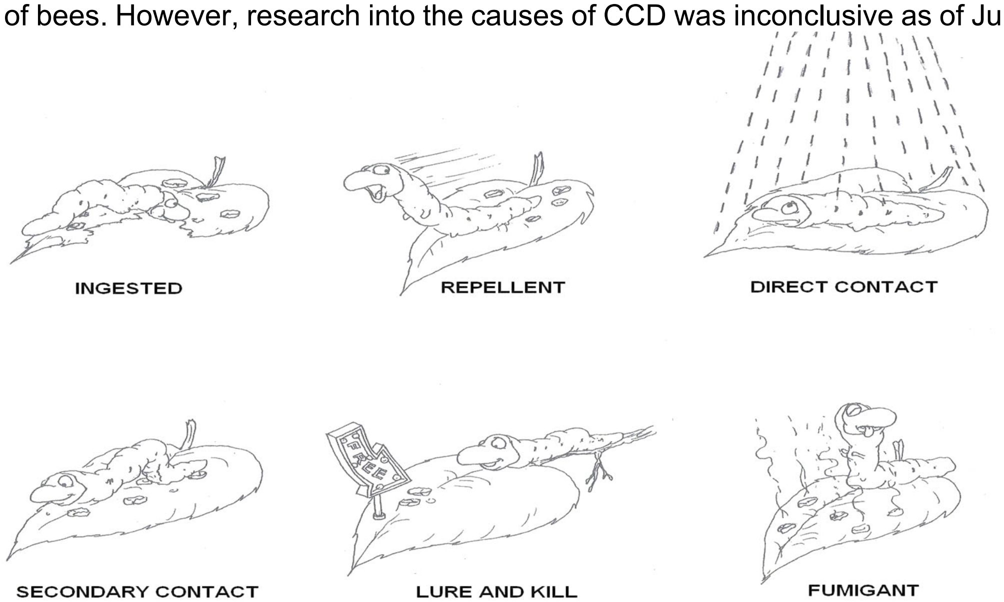
Some insecticides kill or harm other creatures in addition to those they are intended to kill. For example, birds may be poisoned when they eat food that was recently sprayed with insecticides or when they mistake insecticide granules on the ground for food and eat it. Sprayed insecticides may drift from the area to which it is applied and into wildlife areas, especially when it is sprayed aerially. A number of the organochlorine pesticides have been banned from most uses worldwide, and globally they are controlled via the Stockholm Convention on persistent organic pollutants. **These include: aldrin, chlordane, DDT, dieldrin, endrin, heptachlor, mirex and toxaphene.**

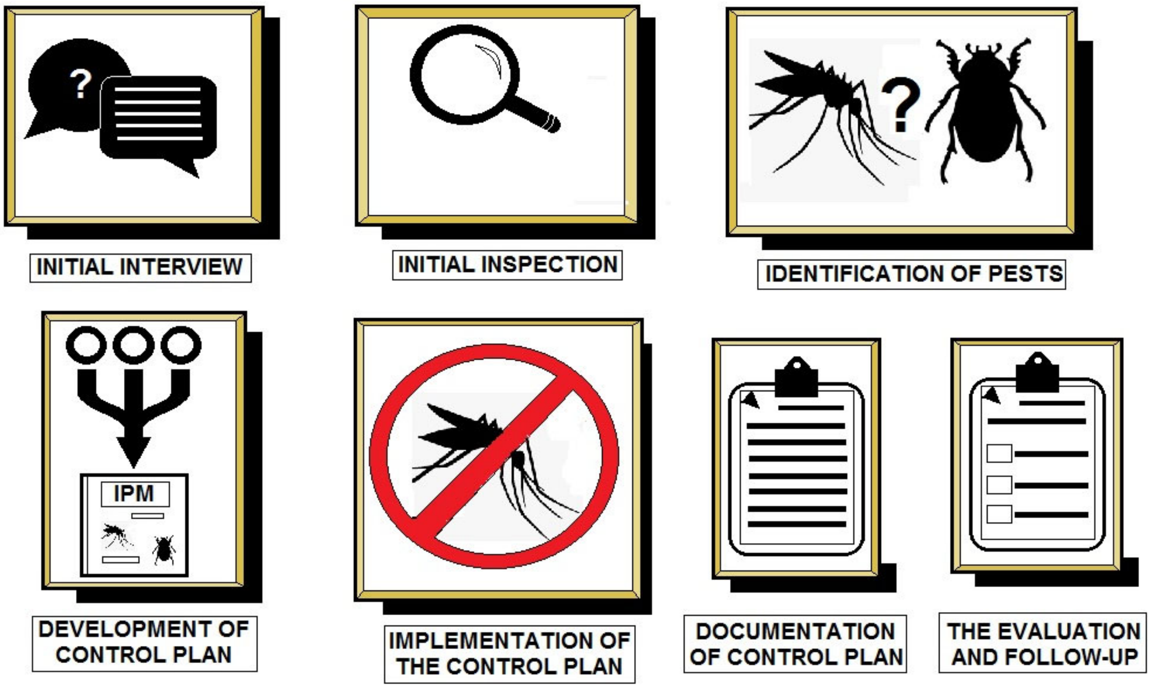
DDT

One of the bigger drivers in the development of new insecticides has been the desire to replace toxic and irksome insecticides. DDT was introduced as a safer alternative to the lead and arsenic compounds. Some insecticides have been banned due to the fact that they are persistent toxins which have adverse effects on animals and/or humans. An oft-quoted case is that of DDT, an example of a widely used (and maybe misused) pesticide, which was brought to public attention by Rachel Carson's book, Silent Spring. One of the better known impacts of DDT is to reduce the thickness of the egg shells on predatory birds. The shells sometimes become too thin to be viable, causing reductions in bird populations. This occurs with DDT and a number of related compounds due to the process of bioaccumulation, wherein the chemical, due to its stability and fat solubility, accumulates in organisms' fatty tissues. Also, DDT may biomagnify, which causes progressively higher concentrations in the body fat of animals farther up the food chain. The near-worldwide ban on agricultural use of DDT and related chemicals has allowed some of these birds, such as the peregrine falcon, to recover in recent years.

Pollinator Decline

Insecticides can kill bees and may be a cause of pollinator decline, the loss of bees that pollinate plants, and colony collapse disorder (CCD), in which worker bees from a beehive or Western honey bee colony abruptly disappear. Loss of pollinators will mean a reduction in crop yields. Sub-lethal doses of insecticides (i.e. imidacloprid and other neonicotinoids) affect foraging behavior of bees. However, research into the causes of CCD was inconclusive as of June 2007.





DEVELOPING AN INTEGRATED PESTICIDE MANAGEMENT PROGRAM (IPM)

IPM Methods (Types of Pest Control Summary)

Conventional Pest Control Verses Integrated Pest Management

“Conventional” Pest Control

1. Chemical intensive
2. Emphasis on Killing pest directly
3. Largely reactive to pest outbreaks
4. Primary purpose of site visits is to apply more pesticide
5. General and overuse of pesticides
6. Less emphasis on prevention

Integrated Pest Management

1. Knowledge intensive
2. Emphasizes modification of conditions that favor pests
3. Systematic program of long-term pest control
4. Major purpose of most site visits is to inspect and monitor
5. Pesticide use is limited in terms of types, amounts and locations
6. Major emphasis on prevention of pest problems

Integrated Pest Management (IPM) is an effective and environmentally sensitive approach to pest management that relies on a combination of common-sense practices. IPM programs use current, comprehensive information on the life cycles of pests and their interaction with the environment. This information, in combination with available pest control methods, is used to manage pest damage by the most economical means, and with the least possible hazard to people, property, and the environment.

The IPM approach can be applied to both agricultural and non-agricultural settings, such as the home, garden, and workplace. IPM takes advantage of all appropriate pest management options including, but not limited to, the judicious use of pesticides. In contrast, organic food production applies many of the same concepts as IPM but limits the use of pesticides to those that are produced from natural sources, as opposed to synthetic chemicals.

IPM is not a single pest control method but, rather, a series of pest management evaluations, decisions and controls. In practicing IPM, growers who are aware of the potential for pest infestation follow a four-tiered approach.

The four steps include:

Set Action Thresholds

Before taking any pest control action, IPM first sets an action threshold, a point at which pest populations or environmental conditions indicate that pest control action must be taken. Sighting a single pest does not always mean control is needed. The level at which pests will either become an economic threat is critical to guide future pest control decisions.

Monitor and Identify Pests

Not all insects, weeds, and other living organisms require control. Many organisms are innocuous, and some are even beneficial. IPM programs work to monitor for pests and identify them accurately, so that appropriate control decisions can be made in conjunction with action thresholds. This monitoring and identification removes the possibility that pesticides will be used when they are not really needed or that the wrong kind of pesticide will be used.

Prevention
As a first line of pest control, IPM programs work to manage the crop, lawn, or indoor space to prevent pests from becoming a threat. In an agricultural crop, this may mean using cultural methods, such as rotating between different crops, selecting pest-resistant varieties, and planting pest-free rootstock. These control methods can be very effective and cost-efficient and present little to no risk to people or the environment.

Control
Once monitoring, identification, and action thresholds indicate that pest control is required, and preventive methods are no longer effective or available, IPM programs then evaluate the proper control method both for effectiveness and risk. Effective, less risky pest controls are chosen first, including highly targeted chemicals, such as pheromones to disrupt pest mating, or mechanical control, such as trapping or weeding. If further monitoring, identifications and action thresholds indicate that less risky controls are not working, then additional pest control methods would be employed, such as targeted spraying of pesticides. Broadcast spraying of non-specific pesticides is a last resort.

Six Basic Components
An IPM system is designed around six basic components: The US Environmental Protection Agency has a useful set of IPM principles.
1. Acceptable pest levels: The emphasis is on control, not eradication. IPM holds that wiping out an entire pest population is often impossible, and the attempt can be economically expensive, environmentally unsafe, and frequently unachievable. IPM programs first work to establish acceptable pest levels, called action thresholds, and apply controls if those thresholds are crossed. These thresholds are pest and site specific, meaning that it may be acceptable at one site to have a weed such as white clover, but at another site it may not be acceptable. By allowing a pest population to survive at a reasonable threshold, selection pressure is reduced. This stops the pest gaining resistance to chemicals produced by the plant or applied to the crops. If many of the pests are killed then any that have resistance to the chemical will form the genetic basis of the future, more resistant, population. By not killing all the pests there are some un-resistant pests left that will dilute any resistant genes that appear.

2. Preventive cultural practices: Selecting varieties best for local growing conditions, and maintaining healthy crops, is the first line of defense, together with plant quarantine and 'cultural techniques' such as crop sanitation (e.g. removal of diseased plants to prevent spread of infection).

3. Monitoring: Regular observation is the cornerstone of IPM. Observation is broken into two steps, first; inspection and second; identification. Visual inspection, insect and spore traps, and other measurement methods and monitoring tools are used to monitor pest levels. Accurate pest identification is critical to a successful IPM program. Record-keeping is essential, as is a thorough knowledge of the behavior and reproductive cycles of target pests. Since insects are cold-blooded, their physical development is dependent on the temperature of their environment. Many insects have had their development cycles modeled in terms of degree days. Monitor the degree days of an environment to determine when is the optimal time for a specific insect's outbreak.

4. Mechanical controls: Should a pest reach an unacceptable level, mechanical methods are the first options to consider. They include simple hand-picking, erecting insect barriers, using traps, vacuuming, and tillage to disrupt breeding.

5. Biological controls: Natural biological processes and materials can provide control, with minimal environmental impact, and often at low cost. The main focus here is on promoting beneficial insects that eat target pests. Biological insecticides, derived from naturally occurring microorganisms (e.g.: Bt, entomopathogenic fungi and entomopathogenic nematodes), also fit in this category.

6. Responsible Pesticide Use: Synthetic pesticides are generally only used as required and often only at specific times in a pests life cycle. Many of the newer pesticide groups are derived from plants or naturally occurring substances (e.g.: nicotine, pyrethrum and insect juvenile hormone analogues), but the toxophore or active component may be altered to provide increased biological activity or stability. Further 'biology-based' or 'ecological' techniques are under evaluation.

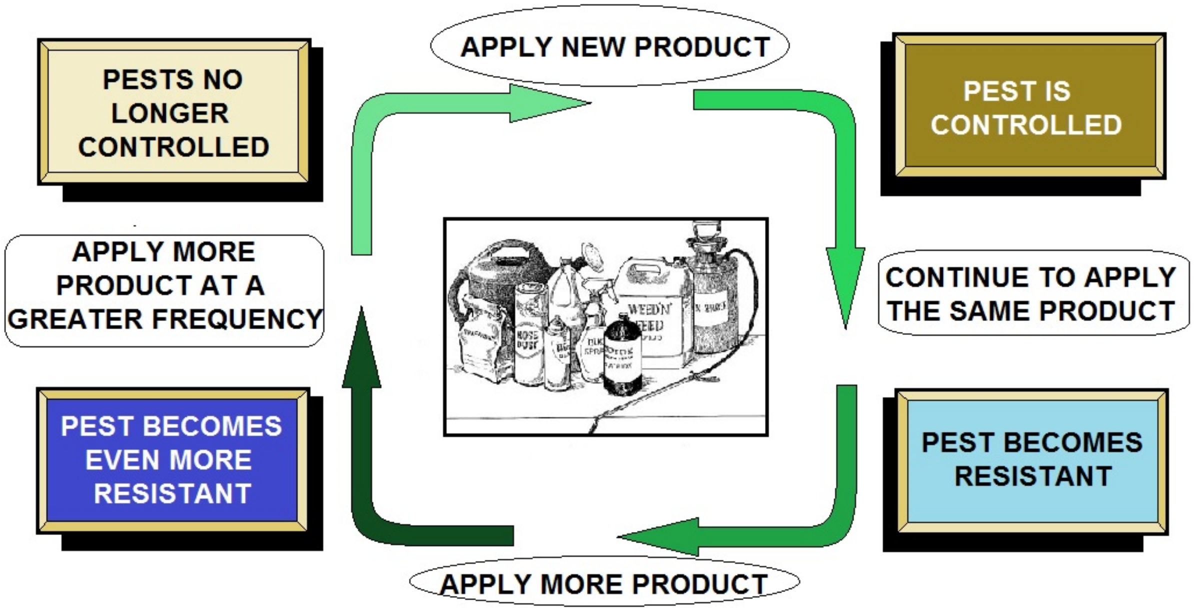
Types of Pesticide Spectrums

Broad-Spectrum

A pesticide that is effective against many pest. An example of a broad-spectrum pesticide is methyl bromide, which is designed to control pests ranging from small insects and pathogens to larger weeds and rodents. The pesticide can be injected into the ground to kill organisms in the soil that might harm the plant while it is growing. It can also be pumped into warehouses or barns to kill pests that could harm the plant during storage or transport for sale.

Narrow-Spectrum AKA Target-Spectrum

Developed to kill specific organism types. An example of a narrow-spectrum pesticide is chitin inhibitors, which are chemicals that interact with chitin, a component of the exoskeleton of insects. This pesticide inhibits the development of chitin and will eventually result in the death of the insect. The chitin inhibiting pesticide will only harm insects that have chitin in their exoskeletons and will not affect other insects.



PESTICIDE TREADMILL DIAGRAM

Main Focus of IPM Programs

An IPM regime can be quite simple or sophisticated. Historically, the main focus of IPM programs was on agricultural insect pests. Although originally developed for agricultural pest management, IPM programs are now developed to encompass diseases, weeds, and other pests that interfere with the management objectives of sites such as residential and commercial structures, lawn and turf areas, and home and community gardens. IPM is applicable to all types of agriculture and sites such as residential and commercial structures, lawn and turf areas, and home and community gardens. Reliance on knowledge, experience, observation, and integration of multiple techniques makes IPM a perfect fit for organic farming (sans artificial pesticide application).

For large-scale, chemical-based farms, IPM can reduce human and environmental exposure to hazardous chemicals, and potentially lower overall costs of pesticide application material and labor.

1. Proper identification of pest - What is it?
Cases of mistaken identity may result in ineffective actions. If plant damage due to over-watering are mistaken for fungal infection, spray costs can be incurred, and the plant is no better off.

2. **Learn pest and host life cycle and biology.**
At the time you see a pest, it may be too late to do much about it except maybe spray with a pesticide. Often, there is another stage of the life cycle that is susceptible to preventative actions. For example, weeds reproducing from last year's seed can be prevented with mulches. Also, learning what a pest needs to survive allows you to remove these.

3. Monitor or sample environment for pest population - How many are here?
Preventative actions must be taken at the correct time if they are to be effective. For this reason, once the pest is correctly identified, monitoring must begin before it becomes a problem. For example, in school cafeterias where roaches may be expected to appear, sticky traps are set out before school starts. Traps are checked at regular intervals so populations can be monitored and controlled before they get out of hand. Some factors to consider and monitor include: Is the pest present/absent? What is the distribution - all over or only in certain spots? Is the pest population increasing or decreasing?

4. Establish action threshold (economic, health or aesthetic) - How many are too many?
In some cases, a certain number of pests can be tolerated. Soybeans are quite tolerant of defoliation, so if there are a few caterpillars in the field and their population is not increasing dramatically, there is not necessarily any action necessary. Conversely, there is a point at which action must be taken to control cost. For the farmer, that point is the one at which the cost of damage by the pest is more than the cost of control. This is an economic threshold. Tolerance of pests varies also by whether or not they are a health hazard (low tolerance) or merely a cosmetic damage (high tolerance in a non-commercial situation).

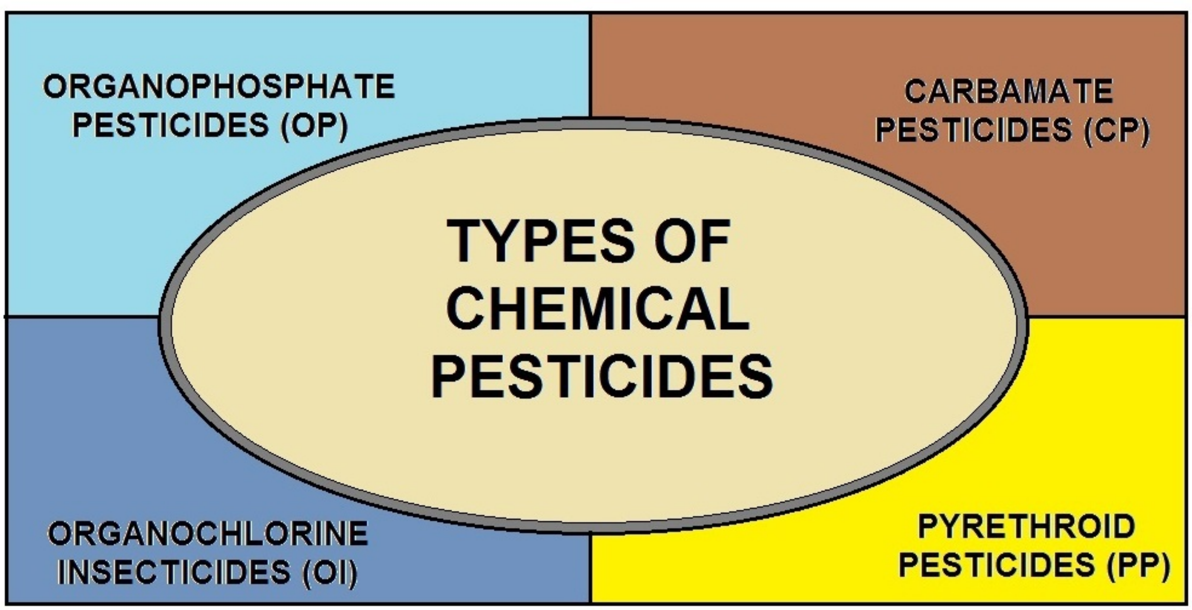
Different sites may also have varying requirements based on specific areas. White clover may be perfectly acceptable on the sides of a tee box on a golf course, but unacceptable in the fairway where it could cause confusion in the field of play.

5. Choose an appropriate combination of management tactics
For any pest situation, there will be several options to consider. Options include mechanical or physical control, cultural controls, biological controls and chemical controls. Mechanical or physical controls include picking pests off plants, or using netting or other material to exclude pests such as birds from grapes or rodents from structures. Cultural controls include keeping an area free of conducive conditions by removing or storing waste properly, removing diseased areas of plants properly. Biological controls can be support either through conservation of natural predators or augmentation of natural predators.

Augmentative control includes the introduction of naturally occurring predators at either an inundative or inoculative level. An inundative release would be one that seeks to inundate a site with a pest's predator to impact the pest population. An inoculative release would be a smaller number of pest predators to supplement the natural population and provide ongoing control.

Chemical controls would include horticultural oils or the application of pesticides such as insecticides and herbicides. A Green Pest Management IPM program would use pesticides derived from plants, such as botanicals, or other naturally occurring materials.

6. Evaluate results - How did it work?
Evaluation is often one of the most important steps. This is the process to review an IPM program and the results it generated. Asking the following questions is useful: Did actions have the desired effect? Was the pest prevented or managed to farmer satisfaction? Was the method itself satisfactory? Were there any unintended side effects? What can be done in the future for this pest situation? Understanding the effectiveness of the IPM program allows the site manager to make modifications to the IPM plan prior to pests reaching the action threshold and requiring action again.

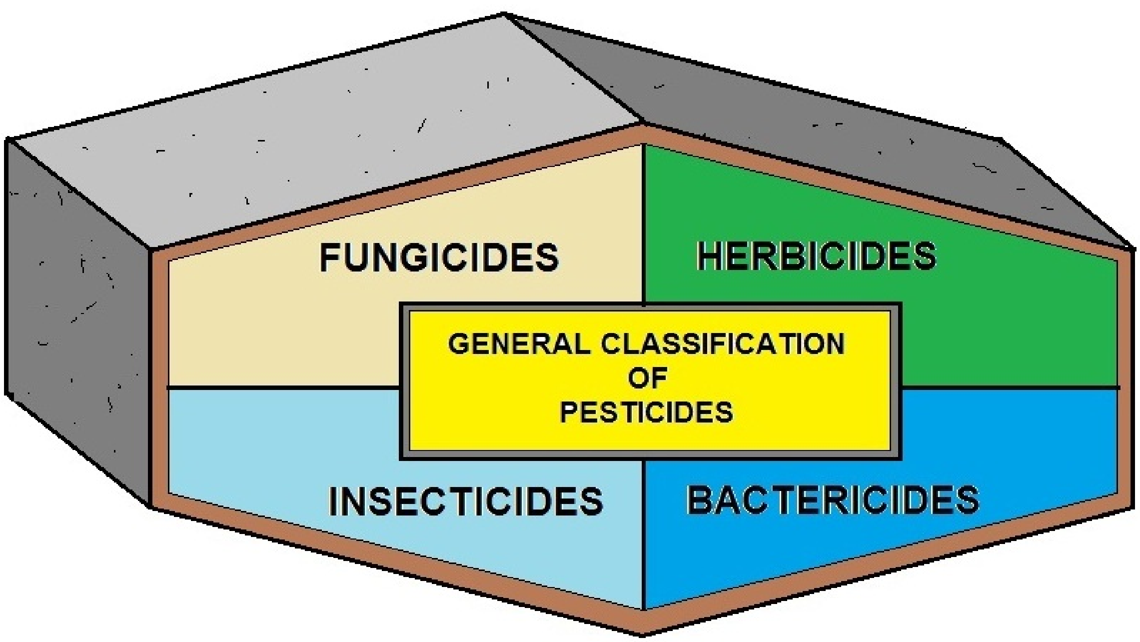


TYPES OF PESTICIDE DIAGRAM

Classes of Agricultural Insecticides

The classification of insecticides can be expressed in several different ways:

- Contact insecticides are toxic to insects brought into direct contact. Efficacy is often related to the quality of pesticide application, with small droplets (such as aerosols) often improving performance.
- Inorganic insecticides are manufactured with metals and include arsenates, copper compounds and fluorine compounds, which are now seldom used, and sulfur, which is commonly used.
- Mode of action—how the pesticide kills or inactivates a pest—is another way of classifying insecticides. Mode of action is important in predicting whether an insecticide will be toxic to unrelated species, such as fish, birds and mammals.
- Natural insecticides, such as nicotine, pyrethrum and neem extracts are made by plants as defenses against insects. Nicotine based insecticides have been barred in the U.S. since 2001 to prevent residues from contaminating foods.
- Organic insecticides are synthetic chemicals which comprise the largest numbers of pesticides available for use today.
- Plant-Incorporated Protectants (PIP) are insecticidal substances produced by plants after genetic modification. For instance, a gene that codes for a specific Baccilus thuringiensis biocidal protein is introduced into a crop plant's genetic material. Then, the plant manufactures the protein. Since the biocide is incorporated into the plant, additional applications at least of the same compound are not required.
- Systemic insecticides are incorporated by treated plants. Insects ingest the insecticide while feeding on the plants.
- Heavy metals, e.g. arsenic have been used as insecticides; they are poisonous and very rarely used now by farmers.



PESTICDE CLASSIFICATION DIAGRAM

More on Insecticides

An insecticide is a pesticide used against insects. They include ovicides and larvicides used against the eggs and larvae of insects respectively. The use of insecticides is believed to be one of the major factors behind the increase in agricultural productivity in the 20th century. Nearly all insecticides have the potential to significantly alter ecosystems; many are toxic to humans; and others are concentrated in the food chain. This course contains pesticide recommendations that are subject to change at any time. These recommendations are provided only as a guide. It is always the pesticide applicator's responsibility, by law, to read and follow all current label directions for the specific pesticide being used.

Due to constantly changing labels and product registration, some of the recommendations given in this writing may no longer be legal by the time you read them. If any information in these recommendations disagrees with the label, the recommendation must be disregarded. No endorsement is intended for products mentioned, nor is criticism meant for products not mentioned. The author and Technical Learning College (TLC) assume no liability resulting from the use of these recommendations.

Evaluating Pesticides EPA
All pesticides sold or distributed in the United States must be registered by EPA, based on scientific studies showing that they can be used without posing unreasonable risks to people or the environment.

Because of advances in scientific knowledge, the law requires that pesticides that were first registered before November 1, 1984, be re-registered to ensure that they meet today's more stringent standards.

In evaluating pesticides for reregistration, EPA obtains and reviews a complete set of studies from pesticide producers, describing the human health and environmental effects of each pesticide. The Agency develops any mitigation measures or regulatory controls needed to effectively reduce each pesticide's risks. EPA then reregisters pesticides that can be used without posing unreasonable risks to human health or the environment. When a pesticide is eligible for reregistration, EPA explains the basis for its decision in a Reregistration Eligibility Decision (RED) document.

Rotenone
Rotenone is an odorless chemical that is used as a broad-spectrum insecticide, piscicide, and pesticide. It occurs naturally in the roots and stems of several plants such as the jicama vine plant. In mammals, including humans, it is linked to the development of Parkinson's disease.

Rotenone is used in solution as a pesticide and insecticide, or in emulsified liquid form as a piscicide. People catch fish by extracting rotenone from plants and releasing it into water. Poisoned fish come to the surface and are easily caught. This method was first practiced by various indigenous tribes who smashed the roots. Fish caught this way can be eaten because rotenone is very poorly absorbed by the gastrointestinal tract of humans, whereas it is lethal to fish because it readily enters the blood stream of the fish through the gills.

Insect Growth Regulators Summary

An insect growth regulator (IGR) is a synthetic chemical that mimics insect hormones.

Reduced Risk
Many IGRs are labeled "reduced risk" by the Environmental Protection Agency, meaning that they target juvenile harmful insect populations while causing less detrimental effects to beneficial insects. Unlike classic insecticides, IGRs do not affect an insect's nervous system and are thus more worker-friendly within closed environments. IGRs are also more compatible with pest management systems that use biological controls. In addition, while insects can become resistant to insecticides, they are less likely to become resistant to IGRs.

Hormonal IGRs
Hormonal IGRs typically work by mimicking or inhibiting the juvenile hormone (JH), one of the two major hormones involved in insect molting. IGRs can also inhibit the other hormone, ecdysone, large peaks of which trigger the insect to molt. If JH is present at the time of molting, the insect molts into a larger larval form; if absent, it molts into a pupa or adult. IGRs that mimic JH can produce premature molting of young immature stages, disrupting larval development. They can also act on eggs, causing sterilization, disrupting behavior or disrupting diapause, the process that causes an insect to become dormant before winter. IGRs that inhibit JH production can cause insects to prematurely molt into a nonfunctional adult. IGRs that inhibit ecdysone can cause pupal mortality by interrupting the transformation of larval tissues into adult tissues during the pupal stage.

Chitin Synthesis Inhibitors
Chitin synthesis inhibitors work by preventing the formation of chitin, a carbohydrate needed to form the insect's exoskeleton. With these inhibitors, an insect grows normally until it molts. The inhibitors prevent the new exoskeleton from forming properly, causing the insect to die. Death may be quick, or take up to several days depending on the insect. Chitin synthesis inhibitors can also kill eggs by disrupting normal embryonic development. Chitin synthesis inhibitors affect insects for longer periods of time than hormonal IGRs. These are also quicker acting but can affect predaceous insects, arthropods and even fish.

In the case of termite control, the slow action of the IGR allows the chemical to be widely spread throughout the colony as the termite workers feed and groom one another. IGRs are, in general, environmentally safe and have very low mammalian toxicity. Some examples are hexaflumuron, diflubenzuron, pyriproxyfen, and methoprene.

Hexaflumuron
Hexaflumuron (hexaflumeron) is an insect growth regulator that interferes with insects' chitin synthesis. It was registered in 1994 — the first active ingredient to be registered as a "reduced risk pesticide" through the U.S. Environmental Protection Agency's (EPA's) reduced risk program, which waives tests for new pesticides that are thought to pose fewer hazards than existing pesticides.

Hexaflumuron is registered for use on termites, and is the active ingredient in the Sentricon™ bait system. It functions by inhibiting the synthesis of chitin, the material that makes up the exoskeleton of insects (Cox, 1997).

Hexaflumuron is a benzoyl-phenylurea termiticide registered for use to control Eastern and Formosan subterranean termites. It is registered for use in above- and below-ground termite bait station systems in food and nonfood areas. Treatment sites may include interior and exterior surfaces of buildings and crawl spaces, fences, utility poles, decking, landscape decorations, trees, and other features which could be damaged by termite foraging and feeding activity.

Hexaflumuron is not approved for use in indoor residences. While it is not a restricted use product, hexaflumuron is sold in conjunction with a service provided by pest-control operators licensed by the state to apply termiticides. As hexaflumuron was first registered in 1994, it was not subject to the reregistration process as required by FIFRA.

The Agency anticipates conducting an ecological risk assessment for hexaflumuron, including an endangered species assessment. For human health, risk assessments may be required if there are changes in current use patterns. Below is a summary of the issues relevant to the registration review process of hexaflumeron.

Environmental Fate and Ecological Risk:

• The application method for hexaflumuron (i.e., bait stations), is viewed by the Agency as a "closed system" with minimal likelihood of environmental exposure. No previous ecological risk assessments or drinking water exposure assessments have been conducted for hexaflumuron.

• The Agency has not conducted a risk assessment that supports a complete endangered species determination. The ecological risk assessment planned during registration review will allow the Agency to determine whether hexaflumuron use has "no effect" or "may affect" federally listed threatened or endangered species (listed species) or their designated critical habitats. When an assessment concludes that a pesticide's use "may affect" a listed species or its designated critical habitat, the Agency will consult with the U.S. Fish and Wildlife Service and/or National Marine Fisheries Service (the Services), as appropriate.

• Considering the environmental fate properties of hexaflumuron and the method of application (i.e., bait stations), hexaflumuron has the potential to enter into the environment via termites eating the bait and then transporting it away from the bait station. Once in the termite, hexaflumuron could be transferred to termite predators, such as birds and mammals. Based on the fate properties of hexaflumuron, it has the potential to bio-accumulate in food webs. Another possible route of exposure where uncertainty exists is the ability of non-target terrestrial invertebrates, such as native ground-dwelling pollinators, to enter the hexaflumuron bait stations. Therefore, future ecological risk assessments of hexaflumuron will include assessing risks associated with exposures of terrestrial animals to hexaflumuron through consumption of contaminated termites and non-target terrestrial invertebrates that may enter bait stations.

• Hexaflumuron's mode of action, fate and transport properties, and toxicity to non-target terrestrial species create the potential for hexaflumuron to reduce survival, reproduction, and/or growth in non-target terrestrial animals including birds, mammals, amphibians, reptiles and terrestrial insects when used in accordance with the current label. These non-target organisms include federally listed threatened and endangered species as well as non-listed species.

• Based on the application methods (i.e., above- and below-ground bait stations) and the environmental fate properties for hexaflumuron, the potential for hexaflumuron to migrate to the soil and to further migrate to surface water and/or groundwater sources is considered minimal. Therefore, ecological risk to aquatic organisms is expected to be low. In addition, unless the use patterns for hexaflumuron change, a drinking water exposure assessment will not be required to support registration review.

Human Health Risk

• Because of the low toxicity of hexaflumuron, and the low-exposure scenarios associated with hexaflumuron products, a human health risk assessment has not been previously conducted.

• Given the current uses, the Agency does not anticipate conducting a human health risk assessment for hexaflumuron to support registration review. However, if in the future new uses or use patterns emerge, human health risk assessments that examine the dietary, residential, aggregate, or occupational risks of hexaflumuron may be required.

• Based on the Agency's review of the available human health toxicity and exposure data for hexaflumuron, no additional data are expected to be required to support registration review.

Diflubenzuron

Diflubenzuron is an insecticide of the benzamide class. It is used in forest management and on field crops to selectively control insect pests. The mechanism of action of diflubenzuron involves inhibiting the production of chitin which is used by an insect to build its exoskeleton. Diflubenzuron is an acaricide/insecticide (insect growth regulator) used to control many leaf eating larvae of insects feeding on agricultural, forest and ornamental plants (e.g. gypsy moths, mosquito larvae, rust mites). Diflubenzuron is used primarily on cattle, citrus, cotton, mushrooms, ornamentals, standing water, forestry trees and in programs to control mosquito larvae and gypsy moth populations. Formulations include a soluble concentrate, flowable concentrate, wettable powder and a pelleted/tableted. Diflubenzuron is applied by airblast, aircraft and hydraulic sprayers.

Regulatory History

Diflubenzuron was first registered as a pesticide in the U.S. in 1976. EPA issued a Registration Standard for diflubenzuron in September 1985 (PB86-176500). A November 1991 Data Call-In (DCI) required additional residue chemistry and ecological effects data. Currently, 29 diflubenzuron products are registered.

Human Health
Assessment Toxicity

In studies using laboratory animals, diflubenzuron generally has been shown to be slightly toxic on an acute basis. It is absorbed by the dermal route and has been placed in Toxicity Category III (the second lowest of four categories). It has also been placed in Toxicity Category IV (the lowest of four categories) for ingestion by the oral and inhalation routes.

Occupational and Residential Exposure

Based on current use patterns, handlers (mixers, loaders, and applicators) may be exposed to diflubenzuron during and after normal use of applications in agricultural and other settings. The Agency is establishing a short-term (1 to 7 days) toxicological endpoint of sulfhemoglobinemia and intermediate-term (1 week to several months) toxicological endpoint of methemoglobinemia.

Human Risk Assessment

Diflubenzuron generally is of low acute toxicity, but affects the hemoglobin of animal in studies. Although the Agency has determined that there is no evidence of carcinogenicity for iflubenzuron per se (Group E); p-chloroaniline (PCA), a metabolite of diflubenzuron, is a probable human carcinogen (Group B2).

The Agency has also determined that pchlorophenylurea (CPU), a metabolite of diflubenzuron that is closely related to PCA but has no adequate carcinogenicity data, is considered as having the same carcinogenicity potential (Q1*) as PCA.

The total cancer risk estimate for PCA and related metabolites for the overall U.S. population is 1 X 10-6. The Rfd is 0.02 mg/kg/day, based on the NOEL of 2.0 mg/kg/day in the 52-week chronic oral study in dogs with a safety factor of 100 to account for interspecies extrapolation and intraspecies variability.

Occupational Exposure
Of greater concern is the risk posed to diflubenzuron handlers, particularly mixers/loaders/applicators. The risk for short-term occupational exposure is acceptable for handlers wearing long-sleeved shirts, long pants and chemical-resistant gloves. The risk for intermediate term occupational exposure is also acceptable, provided dust/mist respirators (TC-21C) are required for mixers, loaders and applicators when working with diflubenzuron for certain higher risk application methods.

Restricted Entry Interval
Post-application re-entry workers will be required to observe a 12-hour Restricted Entry Interval, as set by the WPS. Under the Food Quality Protection Act of 1996, the Agency has determined that there is a reasonable certainty that no harm will result to infants and children from aggregate exposure to diflubenzuron. The total dietary cancer risk for the published tolerances for the overall U.S. population is approximately 1 x 10-6. Since there are no detections of diflubenzuron in ground water, dietary risk from drinking water are expected to be negligible. Based on very low residues detected in forestry dissipation studies, a low dermal absorption rate, and extremely low dermal and inhalation toxicity, occupational uses of diflubenzuron in residential locations, parks, or forests treated with diflubenzuron are expected to result in insignificant risk.

Ecological Effects
Diflubenzuron is practically non-toxic to avian species, small mammals, freshwater fish and marine/estuarine fish on an acute oral dietary basis, while it is slightly toxic to avian species on a subacute dietary basis.

Diflubenzuron is non-toxic to bees. The results indicate that diflubenzuron is very highly toxic to freshwater aquatic invertebrates, including marine/estuarine crustacea, while it is highly toxic to marine/estuarine mollusks. The results indicate that diflubenzuron affects reproduction, growth and survival in freshwater invertebrates as well as reproduction in marine/estuarine invertebrates.

Pyriproxyfen
Pyriproxyfen is a pyridine based pesticide which is found to be effective against a variety of arthropoda. It was introduced to the US in 1996 to protect cotton crops against whitefly. It has also found useful for protecting other crops. It is also being used as a prevention for fleas on household pets. Pyriproxyfen is a juvenile hormone analogue, preventing larvae from developing into adulthood and thus rendering them unable to reproduce. In the US pyriproxyfen is often marketed under the trade name Nylar. In Europe pyriproxyfen is known under the brand names Cyclio (Virbac) and Exil Flea Free TwinSpot (Emax).

Methoprene
Methoprene is a juvenile hormone (JH) analog which can be used as an insecticide that acts as a growth regulator. Methoprene is an amber-colored liquid with a faint fruity odor which is essentially nontoxic to humans when ingested or inhaled. It is used in drinking water cisterns to control mosquitoes that spread malaria.

Control Methods Summary

All ant/termite control methods can be categorized as either whole structure or localized. A whole-structure treatment is defined as the simultaneous treatment of all infestations, accessible and inaccessible, in a structure. Localized or spot treatment is more restrictive and is often applied to a single board or small group of boards. Homeowners are advised to understand the distinction between whole-structure and localized treatments when deciding which method to select, because all treatment methods are not equal.

Whole-structure treatments have an advantage over localized treatments in that they should eliminate all infestations, even hidden ones. With the uncertainty of current detection methods, particularly when drywall or other wall coverings conceal infestations, there is always some doubt as to the extent of drywood termite colony boundaries and the number of colonies within homes. Consequently, one can never be sure all infestations have been treated when applying localized treatments.

Whole-Structure Treatment or Fumigation
Sulfuryl fluoride treats all infestations simultaneously and has high levels of efficacy, if correctly applied. Sulfuryl fluoride kills drywood termites within several days. A monitored fumigation, which involves installing gas monitoring lines inside the structure undergoing treatment, has the highest rate of treatment success.

Non-monitored fumigation may not have enough gas concentration to kill infestations, and failures may occur. The advantage of fumigation over localized treatment is that it should eliminate infestations hidden from view. It will also be necessary for the occupants, pets, and plants to vacate the structure for several days (depending on volume of structure and amount of gas injected) while it is being fumigated and then aerated. Additionally, roofs could be damaged as a result of having tarpaulins dragged across them.

Heat
Heat is a nonchemical option for whole-structure treatment. The treatment process involves heating all wood in the structure to a minimum of 120°F and holding this temperature for at least 33 minutes. The benefit of heat treatment is the ability to treat the entire structure without using chemicals and the relatively short period of time the structure must be vacated—hours instead of days, as with fumigation.

An additional advantage is that portions of large structures can be treated separately, which is very useful in apartments and condominiums. The major drawbacks of heat treatments include the difficulty in raising the internal core temperature of large infested structural beams (could take many hours or days depending on wood volume treated) and the potential for heat sinks, areas within the structure that are difficult to heat such as wood on concrete or tile.

New heat emitters have been developed, but the ability of these heating devices to rid all infestations from large structures with many layers of wall coverings still remains unclear. Other issues to consider include damage to heat-sensitive items in homes, including plastics (e.g. electrical outlet covers) and cable wiring. Also, like fumigants, heat treatments have no residual effect. For long-term protection, preventive chemicals can be applied to areas treated with fumigants or heat.

Localized Treatments
There are many localized treatment methods available that include both chemical and nonchemical options. For liquid and dust insecticides to be effective, termites must make contact with them or ingest them. Localized treatments should be applied only by licensed applicators. Home-use products are not effective. Depending on the material used for localized treatments, laboratory and field studies have shown considerable variation in their effectiveness in controlling termites. Research indicates that if you correctly locate the colony and get the chemical or nonchemical treatment directly onto the termites, the effectiveness of control will be high. For failed treatments, an additional callback treatment may lead to better results; and the use of termite detection equipment enhances the performance of any localized treatments applied. Botanical-based products (e.g., orange oil and neem oil) have been tried, but recent lab and field tests from two universities question the efficacy of at least d-limonene (Lewis and Rust 2009, Lewis, et al. 2009 in References).

Approved Treatments Include:
- Liquid soil-applied termiticides.
- Termite baits.
- Building materials impregnated with termiticides.
- Wood treatments.

Two common forms of treatment are **conventional barrier treatments** and **termite baits**. There are two basic kinds of liquid pesticides used on termites: **repellants** try to create a chemical barrier that termites cannot pass. The chemicals repel termites, and they will not cross the barrier to get into the home.

Non-repellants just kill the termites when they cross the barrier.

Liquid treatments using a pesticide called a "termiticide" (because it kills termites) work by trying to create a barrier around your house with chemicals, so that termites cannot pass and come in to start a colony. Again, Research indicates that if you correctly locate the colony and get the chemical or nonchemical treatment directly onto the termites, the effectiveness of control will be high.

The main reasons that you would want to go with a liquid version are that it works immediately (whereas bait can take months to kill a colony) and that it is cheap. It can also last much longer than bait, as the chemicals will linger in the soil killing termites for several years.

Termidor is the most prominent of these. It has got several advantages compared to the traditional liquid termiticides: instead of requiring gallons and gallons pumped into the ground, only a small amount (ounces) is used. It uses fipronil, a chemical that is much safer environmentally. It is designed to kill termites (whereas older chemicals were designed to repel them). However, it is more expensive than other liquid treatments.

Specific Products:

Advance (bait)
Bayer Advanced Termite Killer (granules)
Bayer Advanced Termite Killer Plus
Bifen I/T Insecticide Spray
Bonide
Bora Care (borate)
Delta Dust Multi Use (Our Top Pick)
Deltamethrin (dust)
Exterra (bait)
FirstLine (bait)
Jecta Gel (borate)
Nibor-D (borate)
Optigard (foam)
Orange Oil (liquid)
Ortho Home Defense MAX Termite and Bug Killer
Permethrin Pro (liquid)
Phantom (liquid)
Premise (liquid)
Sentricon Termite Control (bait)
Spectrum (DIY bait)
Subterfuge (bait)
Termidor (liquid)
Termidor Termiticide Foam (Our #2 Pick)
Terminate (bait)
Tim-Bor (borate)
Vikane (fumigation)

Read the pesticide product label

The label tells you exactly how the product is to be used and provides information on potential risks. If the label does not include directions to control termites and protect the structure, then the product is not intended to protect the structure against termites and should not be applied. If you wish to see a copy of the product label, ask the company representative for a copy. Always be prepared to provide a copy of the label information to the business or homeowner. We cannot stress the dangers of pesticide application and the high death and injury rate due to applicators not following label instructions.

Be aware of the how soon you can return to the treated residence - The time required before the residence can be re-occupied will vary by product and will be indicated on product labels. Make sure to inform the business or homeowner when it is safe to reenter the building.

Liquid Application with Repellent

This combination of methods involves using liquid pesticide in the same manner described above. However, instead of using bait as an additional form of termite prevention, this method combines the liquid pesticide application with an application of termite repellent. The benefit of using a repellent product instead of a bait product is that repellents can be used both inside and outside the home. If a termite gets past the barriers to entry (the liquid repellent), the termite will encounter the repellent that makes the environment inhospitable.

The downside to using repellents is that termites know that the repellent is present and they avoid the area instead of eating the bait and taking it back to the colony, which would eliminate more termites.

Liquid Application with Bait and Monitoring
A liquid application with bait and monitoring combines three methods to ensure complete, safe removal of termites from the home. First, a liquid pesticide called termiticide is injected under the ground at entry points to the house, such as doorways and windows and along the foundation. Some entry points may not be obvious to the layperson, and injecting the liquid is dangerous, so a professional is required.

With this termite removal method, bait is also used. Bait involves placing material that termites like to eat -- such as cardboard or paper -- in special underground stations where termites are likely to travel. The edible material is laced with lethal poison that acts slowly to kill the termites. The hope is that termites will ingest the substance and carry it back to the nest, sharing it with other termites.

Finally, monitoring stations are used to detect the presence of termites in or near the home. If termites are suspected, the monitoring stations will be replaced with bait. Using this method allows you to ensure that your home is free of termites without the continuous presence of lethal bait around your home.

Termite Baits
In recent years, several bait systems have been introduced to help reduce the overall use of insecticides and their impact on human health and the environment. These systems rely on cellulose baits that contain a slow-acting insecticide.

The most common active ingredients found in termite baits are:
- Diflubenzuron - inhibits insect development.
- Hexaflumuron- first active ingredient registered as a reduced-risk pesticide. It is used as part of a termite inspection, monitoring, and baiting system.
- Hydramethylnon
- Lufenuron- an insect growth regulator used to control termites and fleas.
- Noviflumuron disrupts termite growth and activity.

Read the pesticide product label - The label tells you exactly how the product is to be used and provides information on potential risks. If the label does not include directions to control termites and protect the structure, then the product is not intended to protect the structure against termites and should not be applied. If you wish to see a copy of the product label, ask the company representative for a copy. Always be prepared to provide a copy of the label information to the business or homeowner. We cannot stress the dangers of pesticide application and the high death and injury rate due to applicators not following label instructions.

Be aware of the how soon you can return to the treated residence - The time required before the residence can be re-occupied will vary by product and will be indicated on product labels. Make sure to inform the business or homeowner when it is safe to reenter the building.

Fumigation
Fumigation involves tenting the entire home and spraying a combination of gases (usually sulfuryl fluoride and methyl bromide) that is poisonous to termites. The benefit to this method of treatment is that the entire home is treated, and all colonies that are hidden throughout the home are immediately destroyed. However, you need to leave your home during the fumigation process and generally for several days afterward, as the chemicals are very poisonous. Mattresses must be removed from the house as well, and exterior plants close to the home need to be trimmed.

Conventional Barrier Treatments
The most common technique for treating termite infestations is the soil-applied barrier treatment. Termiticides used for barrier treatments must be specifically labeled for that use. If conducted improperly, these treatments can cause contamination of the home and surrounding drinking water wells and will not protect against termites.

For that reason, it is important to hire a pest management professional who is licensed and trained to take proper precautions. The most common active ingredients found in conventional termiticides are:

- Acetamiprid
- Bifenthrin
- Chlorantraniliprole
- Chlorfenapyr
- Cyfluthrin
- Cypermethrin
- Esfenvalerate
- Fipronil
- Imidacloprid
- Permethrin

Wood Treatment
- Borates - commonly used as a spray on application during new home construction to protect wood.

Four Nonchemical Options
There are four nonchemical options for drywood termite control with localized or spot application, including heat, which is used for both spot and whole-structure treatments. The advantages and disadvantages discussed for heat as a whole-structure treatment also apply to spot treatments.

Microwave Devices
Microwave devices are also available for control. Microwaves kill termites by causing fluids inside their cells to boil, which destroys cell membranes; in short, the termites are cooked inside the wood. There are few firms now offering microwave treatments. One advantage of microwaves is their relative portability; another is that they leave no chemical residue. When using microwaves, however, detection accuracy is critical to success. Microwaves may damage the surface or interior of wooden boards, depending on the power of the device; the wattage or power of microwaves may vary from several hundred to more than 10,000 watts. Lab studies revealed no relationship between increasing microwave wattage and drywood termite mortality. As with heat treatments, it may be difficult to use microwaves to heat areas with potential heat sinks to high enough temperatures for effective control.

High Voltage Electricity

High voltage electricity, or electrocution, is another nonchemical option. The device used emits high voltage (90,000 volts) but a low current (less than 0.5 amps). Death to drywood termites occurs by electric shock, although delayed mortality may also occur from the destruction of intestinal protozoa. The advantage of electrocution is that the equipment is portable. The limitations include detection accuracy and possible reduced efficacy from the interfering actions of common building materials (e.g., metal, concrete, and glass).

If drill holes are used to enhance the flow of the current into wood, some damage occurs to wall coverings, walls, and structural wood members.

Wood Replacement

Wood replacement is another remedial treatment option. However, similar to other localized treatments, its effectiveness is highly dependent on detection accuracy, as well as the extent and location of the infestation.

Furthermore, if the infested wood is load bearing either an architect, engineer, and/or general contractor should be consulted; and building permits may be necessary, adding expense. Lastly, the use of insect pathogens and parasites directed at drywood termite control has been limited, and most attempts have been reported as failures.

Long-Term Preventive Treatments

Several approaches to preventing drywood termites from attacking un-infested wood. Methods include chemical treatments, pressure-treated wood, barriers, and resistant wood species.

Wood preservatives and pressure-treated wood (i.e., chemically treated wood that is green and sometimes brown in color) are commonly used for structural pest prevention in California. However, efficacy can be less than expected due to differences in wood destroying pest susceptibility, concentration and penetration of active ingredients in wood, the degree of drilled holes and carpentry cuts in lumber used for installation leading to breaches in chemical barrier, and leaching of chemical from exterior applications due to rain.

Currently, dozens of chemical products are registered in federal and state databases for long-lasting prevention against drywood termite infestations. However, although simulated field trials have shown efficacy of some products against termites in Florida, there are no field studies documenting their field performance on termites that occur in California. This type of research would be required to formulate guidelines for use of preventive chemicals in California.

Drawbacks

Drawbacks with some chemical preventive treatments may include damage from drill holes, unsightly appearance from applying dusts, and potential hazards of some products to applicators.

Topic 5 - Advanced Termite/Ant Management Section Post Quiz
Answers in Rear after the Glossary

Fumigation Application
1. When which chemical (liquefied gas or liquefied gas under pressure) is used as a fumigant, it is introduced into the treated site with approved tubing where it disperses as a gas for quick distribution throughout the fumigated area?

Adjacent Enclosed Area
2. If people or domestic animals may enter into this area during the fumigation or aeration process, you are required to conduct monitoring to be sure no one is exposed above the permitted level of ______________on an 8-hour time weighted average.

Fumigation Management Plan
3. A Fumigation Management Plan (FMP) is a suggestion of the steps designed to plan for a safe, legal and effective fumigation.
True or False

4. All fumigants are dangerous, and their use requires specific training. All fumigants are restricted-use pesticides for application by trained and certified pesticide applicators only. This publication is intended to assist applicators who meet these requirements. It is always advisable, however, to consider using the services of a professional commercial fumigator to reduce both risk and liability.
True or False

Termite Control Methods Summary
5. All termite control methods can be categorized as either?

Heat
6. Heat is a nonchemical option for whole-structure treatment. The treatment process involves heating all wood in the structure to a minimum of ______________and holding this temperature for at least 33 minutes.

Liquid Application with Bait and Monitoring
7. Bait involves placing material that termites like to eat -- such as cardboard or paper -- in special underground stations where termites are likely to travel. The edible material is laced with lethal poison that acts slowly to kill the termites. The hope is that termites will ingest the substance and carry it back to the nest, sharing it with other termites.
True or False

8. Monitoring stations are used to detect the presence of termites in or near the home. If termites are suspected, the monitoring stations will be replaced with bait. Using this method allows you to ensure that your home is free of termites without the continuous presence of lethal bait around your home.
True or False

9. Microwaves will not damage the surface or interior of wooden boards, regardless on the power of the device; the wattage or power of microwaves may vary from several hundred to more than 50,000 watts.
True or False

High Voltage Electricity
10. High voltage electricity, or electrocution, is another nonchemical option. The device used emits high voltage (90,000 volts) but a low current (less than_________________).

Glossary

Adventive: Located outside habitat, though a reproductive population may not be established.
Alates: Winged forms of insects.
Anthocorids: A true bug in the family Anthocoridae.
Aphid: An insect in the family Aphidiidae which are sometimes called plant lice.
Alien: Same as non-native.
Beneficial insect: Any insect that has a lifestyle that is advantageous to man. Insects that preserve the balance of nature by feeding on others; pollinators and recyclers are examples of beneficial insects.
Cephalothorax: Head (ceph) and chest (thorax) area.
Cerci: Paired appendages on the end of the abdomen of many insects, which are used for sensing, defense, or mating.
Chewing (mouth parts): Any mouth part that literally bites to feed; other mouth part types are sucking and rasping.
Clavus: The enlarged terminal antennal segments that form a club.
Collophore: A tube-like structure on the underside of the first abdominal segment (folds under the body) of Collembola (e.g. springtails) that is used as a spring action for leaping.
Colonizing: An ant species which is successful at creating nests in new areas. While some exotic ants are successful colonizers, many colonizing species are not exotic -- and many exotics are not colonizers.
Compound eyes: The large multi-faceted eyes of insects.
Coreids: A member of the family Coreidae which are leaf footed bugs**.**
Corium: The elongated, thickened basal portion of the fore wing of Hemiptera.
Cornicles: Tubular structure on each side of abdominal region from which pheromones or honeydew is expelled.
Coxa (pl.=coxae): Basal portion of the leg.
Crepuscular: Having activity periods during low light levels at dawn and evening.
Cursorial: Adapted for running.
Dactyl: Literally a finger or fingerlike projection on an insect body part.
Dealates: Winged forms that have shed their wings, like reproductive termites or ants.
Defoliate, defoliation: Removal of foliage from plants, often by chewing insects.
Detritivore: Any organism that eats decaying organic matter.
Diapause: An insect resting stage, usually induced by environmental signals or extreme conditions, like winter or summer.
Dimorphic: Having two distinct forms.
Endosperm: A portion of a seed that contains most of the energy reserves for germination.
Estivation (aestivation): A resting stage (quiescence) resulting from continued high temperature or xeric conditions; diapause; hibernation.
Exoskeleton: The outer portion of an insect body, which may be relatively soft like a caterpillar or hardened like many beetles.
Femora: A segment of an insect leg; usually the largest segment.
Filiform: Linear shaped, as the antennae of ground beetles.
Forbs: Any broadleaf, non-woody (herbaceous) plant.
Frass: Solid larval insect excrement; plant fragments made by wood-boring insects, usually mixed with excrement.
Furculum (plural: furcula): The elongated fork-like appendage on the end of the abdomen.
Exotic: Same as non-native.
Genera: Plural of genus; A genus is a group of plants or animals with similar characteristics. Animals (insects) are classified by kingdom, phylum, class, order, family, genus, species, and author's name. For example, the honey bee is classified as Animal

(kingdom), Arthropoda (phylum), Insecta or Hexapoda (class), Hymenoptera (order), Apidae (family), *Apis* (genus), *mellifera* (species), Linnaeus (author's name). The genus and species are always italicized.
Girdle, girdling: Damage of a plant that circles the stem or branch, cutting off the connective plant tissue.
Grigology: The study of crickets, grasshoppers, and katydids.
Hemelytron: The first wing of a true bug (Hemiptera) which has the base more thickened than the membaneous outer portion.
Hopperburn: Leaf damage caused by leafhopper feeding, which is a yellowing of the leaves.
Imago: The adult stage of an insect.
Instar: An insect stage between molts; molting is growth.
Internode: The part of a plant stem between the nodes. Nodes mark the point of attachment of leaves, flowers, fruits, buds, and other stems.
Introduced: Same as non-native.
Invasive: A species that is spreading its geographic range into niches occupied by other species. Documentation of an invasive species requires an ecological study to demonstrate the displacement of other species.
Larval stage (larva, larvae): An immature insect, sometimes used to include all immature stages, even eggs. Usually this term refers more specifically to the feeding stages of insects with complete metamorphosis, like grubs, caterpillars, and maggots.
Maggot: In most Diptera (flies), legless larva lacking a distinct head, with cephalic (head) end pointed and caudal (rear) end blunt.
Mesophyll: Fleshy plant tissue inside a leaf or stem.
Metamorphosis: A change in form during an insect's growth and development.

Gradual metamorphosis - Incomplete metamorphosis in which there is no pupal stage and the immatures and adults look similar excluding the wings of the adults.

Incomplete metamorphosis - Any metamorphosis type that does not include the pupal stage. Incomplete metamorphosis is present in Orthoptera (grasshoppers), Hemiptera (true bugs), and several other orders.

Simple metamorphosis - Any metamorphosis that occurs in insect groups where they are not winged and have no pupal stage. Insect groups with simple metamorphosis include the Collembola (springtails) and Thysanura (silverfish).

Metathorax: The second section of the insect thorax which houses the second pair of legs and the first pair of wings.
Mite: A member of the order Acari (ticks and mites).
Molt, molting process: In insects, as in snakes, the process of shedding the exoskeleton.
Naiad: A term for immature insects that are aquatic from the orders Plecoptera, Odonata, and Ephemeroptera. This term is becoming archaic and is now replaced by the more general term "***immature***" insect.
Necrosis: Death of tissue in plants or animals.
Nymphs: An immature stage of hemimetabolous insects (those with incomplete metamorphosis).
Native: These definitions do not necessarily define *where* a species is native. Sometimes the non-native status of a species is clear from previous collections and existing knowledge from biogeography and systematics. Other times, boundaries are a lot blurrier. Is a species non-native if it has been there for 400 years?
Non-indigenous: Same as non-native.
Non-native: A species that is established outside its native habitat. With respect to ants, ants not in an established reproducing colony.
Oothecae: A bean-like hardened egg capsule produced by female Ants.
Osmeterium (pl.=osmeteria): Scent-producing area behind the tibia.

Overwinter: Time spent during the winter months. Insects are often in hibernation or at least rather immobile in the colder temperatures.
Ovipositor: The egg laying apparatus of an insect. The stinger of a bee is actually a modified ovipositor.
Parthenogenesis: Egg development without fertilization.
Pedipalps: Second pair of appendages of the cephalothorax corresponding to the mandibles of insects.
Petiole: Attachment of a leaf to stem.
Phloem and Xylem: Vascular tubes that allow fluid transport in plants. It is the way plants receive and distribute nutrients, hormones, and water.
Photosynthesis: The chemical process that plants use to convert carbon dioxide and water to sugars and ultimately to energy.
Phyto- (prefix): Plant.
Phytophagous: Plant eating; an insect using plants as a food source.
Phytotoxemia: A toxic reaction in plants.
Poikilotherm: A cold-blooded organism.
Proboscis: A nose, or in the case of butterflies, the coiled sucking mouthpart.
Pronotum: The plate on top of the prothorax.
Prothorax: The front part of an insect thorax that includes the attachment points for the front legs.
Protozoan: A microorganism in the kingdom Protozoa.
Pseudergates: Caste found in the lower termites (Isoptera), comprised of individuals having regressed from nymphal stages by molts eliminating the wing buds, or being derived from larvae having undergone non-differentiating molts, serving as the principle elements of the worker caste, but remaining capable of developing into other castes by further molting.
Psocids: Any insect in the order Psocoptera, which includes booklice and barklice.
Psyllid yellows: A virus disease of potatoes, tomatoes, peppers, and eggplant. See purple top.
Pupal stage (pupa): The stage in complete metamorphosis between larva and adult, like the cocoon in moths.
Purple top: A purple discoloration of foliage tips caused by insect transmitted virus.
Pustulate: Pus-forming, as in spider bites.
Rhopalid: An insect in the family Rhopalidae in the order Hemiptera (true bugs).
Rosetting: Malformation of a plant resulting in a bunched irregular growth of the leaves.
Scutellum: A triangular shaped section on the back of Hemiptera and some Coleoptera. It is often the identifying characteristic of Hemipterans or true bugs.
Secondary reproductive: A caste of subterranean termite; also called supplemental reproductives; If these termites develop from nymphs, they are called secondary reproductives (primary reproductives are the king and queen). If they develop from pseudergates, they are called tertiary reproductives. Supplementals may be responsible for most of the egg production in the colony.
Spinneret: A small tubular appendage from which silk threads by spiders and many larval insects.
Stippling (leaf): A speckled appearance of a leaf, usually yellowish spots on a green leaf.
Stolon: An underground portion of a plant that grows horizontally, as in sod-forming grasses.
Subgroup: A subset of a group with related characters. The term group is a general and non-specific collection of similar organisms regardless of taxonomic hierarchy.
Subimago: The first winged stage of a mayfly. This is the only group to have a winged stage that molts. The final stage is the imago, or adult.
Tarsi: A foot. Insect feet are made of several segments and may have pads, hairs, or hooks.
Tegmina: Plural of tegmen, a hardened covering like the forewing of many Orthoptera and Hemiptera.

Tenaculum: A minute 2-pronged structure on the underside of the third abdominal segment of Collembola (springtails), which holds the furcula (appendage used for jumping) before it is released to jump.
Termite: Any wood-eating insect in the order Isoptera.

Soldier termite - A caste of termites with specific structures to defend the colony, such as large mandibles or nasute mouths that produce sticky defensive substances.

Worker termite - A caste of termites that do most of the work in the colony. Worker termites can be all immature termites and forms that do not develop into reproductive forms or soldiers.

Tertiary reproductive termite: See secondary reproductive.
Tettigoniid: A family of Orthoptera often called long-horned grasshoppers, which includes katydids.
Thorax: The second body segment of an insect. The thorax has all of the wings and legs attached to it.
Tip burn: A yellow or dried tip on a branch or leaf caused by insect feeding or a plant physiology disorder.
True bugs: Insects in the order Hemiptera. They are usually characterized by a scutellum, a triangular-shaped section on the back.
Tramp: A widespread ant species spread by human commerce with a specific syndrome of life history characteristics: extreme polygyny, unicolonial or highly polydomous nest structure, and colony reproduction by budding.
Transferred: Collected outside native habitat, without knowledge of established nests.
Transported: Same as transferred; often refers to animals found in quarantine inspection.
Venation: The pattern of veins in the insect wing or in plant leafs.
Wing pads: Incomplete wing structures, like those formed on immature grasshoppers.

Post Quiz Answers

Topic 1 - One Node Ant Identification and Control Section
1. False, 2. True, 3. Carpenter, 4. Insecticide dust or spray, 5. True, 6. False, 7. True, 8. False, 9. True, 10. False

Topic 2 - Two Node Ant Identification and Control Section
1. False, 2. True, 3. 80% to 90%. 4. Demand, Suspend, or Tempo. 5. False, 6. True, 7. False, 8. Signs and symptoms, 9. Nearest poison control center, 10. Product label

Topic 3 – Termite Introduction
1. Subterranean, 2. False, 3. True, 4. False, 5. True, 6. False, 7. True, 8. Drywood 9. Pacific dampwood 10. Desert Dampwood

Topic 4 – Ant and Termite Management Answers
1. False, 2. Oxygen 3, Phantom®, 4. Termidor®, 5. True 6. True 7. True 8. True 9. Removing the tubes, 10. Construction phase

Topic 5 - Advanced Ant and Termite Management Section Post Quiz
1. Liquid phosphine, 2. 0.3 ppm, 3. False, 4. True, 5. Whole structure or localized, 6. 120°F, 7. True, 8. True 9. False, 10. 0.5 amps

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