

Integrated Pest Management Curriculum for the Argentine Ant

Curriculum Outline

Time Required: 4 hours (11:00 am to 3:00 pm: 3 ½ hours of class time and ½ hour for lunch)
Suggested Class size: 15 to 20 participants

Objectives:

1. Learn to distinguish Argentine ants from other pest ant species using the naked eye, a hand lens, and behavioral clues.
2. Learn about how to use a microscope and an insect key to identify ants.
3. Understand how Argentine ant biology affects the success of management practices.
4. Learn about effective habitat modification, physical, and chemical management techniques, their advantages and limitations, and explore examples of appropriate uses for each technique.
5. Use group exercises to gain more insight into evaluating management alternative for particular sites.

Synopsis of Class

A. Lecture and Discussion

1. Introduction, page 3

Discuss the ecological predominance of ants, role in the ecosystem, benefits to humans. Explain social structure and complete metamorphosis.

2. Identification, page 4

Discuss characters that identify the Argentine ant. Explain reasons for status as a nuisance pest and its interference with biological control.

3. Biology and Management, page 4

Explain which biological facts are important for management and how they affect management. Discuss components of an IPM program including monitoring techniques.

B. Hands-on Exercises

Exercise 1—Identifying Ants, page 6

Guide students through a simple pictorial key to identify unknown ants using a microscope.

Exercise 2—Observing Ant Bait Stations at Work, page 12

Take class outside to examine ant bait stations with sugar water and bait stations with bait.

Exercise 3—IPM Plan for a Residential Community, page 14

Students read notes from an inspection of a housing development in Santa Barbara and answer questions together in small groups about how to best manage the ant problem at the site. Each group presents its finding to the rest of the class.

C. Class exam for the Structural Pest Control Board (SPCB), page 22

Students take a short exam to qualify for continuing education credits from the SPCB.

Materials and Equipment for Class

- Handouts (included starting page 23)
 1. Important Biological Facts about the Argentine Ant
 2. Summary of Ant Management Techniques Compatible with and IPM Program
 3. Important Facts about Baiting for Argentine Ants
- References and Resources, page 28
- Visual aids—slides of ants to be discussed (or enlarged photos), other photos to illustrate lecture
- Specimens—the Argentine ant and 2 others chosen from the following list:
Pharaoh ant, odorous house ant, carpenter ant, pavement ant, red imported ant, southern fire ant, and thief ant. These should be preserved in separate vials of alcohol and labeled 1, 2, 3. Make a note of the identity of each vial.
- Monitoring tools—flashlight, telescoping mirror, kneepads, small clawed gardening tool for pulling back mulch and for locating nests, small vial filled with alcohol and Ziploc bag for specimens, binoculars for looking at trees and roofs, needle-nosed pliers for lifting carpeting in corners
- Products and tools used in management—a variety of ant baits (liquid, gel, granular), a variety of bait stations (self-contained pre-filled stations and a variety of fillable stations), diatomaceous earth, bulb duster for diatomaceous earth, vacuum, caulk and caulking gun
- Supplies and equipment for exercises
For identification exercise:
 1. Microscopes and lights—one of each for every 4 to 6 students
 2. Computer with internet connection and projection box
 3. Petri dishes or other small glass or plastic dishes for examining specimens under the microscope
 4. Probes for manipulating ants under the scope—one for each microscopeFor the ant baiting exercise:
 5. Ant bait stations that will hold liquid bait: there must be 2 sets, at least one bait station for plain sucrose water and at least one for each of the baits chosen (see below)
 6. 25% sucrose water
 7. Several different liquid boron-based baits—note: Terro is a good choice, but it should be diluted with water at least by half so it is not as viscous.For the Ant IPM Plan exercise:
 8. Instructions with inspection notes and IPM plan form, page 14
 9. Photos of site inspected, pages 18 & 19

Integrated Pest Management Curriculum for the Argentine Ant (*Linepithema humile*) Lesson Plan

1. Introduction

It is estimated that there are around 5 million species of insects in the world. About 20,000 of those species are ants and fewer than 11,000 ant species have been described.

In the Brazilian rainforest, the biomass of ants exceeds that of vertebrates by 4 times. It is estimated that ants make up about 15% of the terrestrial animal biomass.

Although it may not seem like it at times, ants are actually beneficial. Ants provide an ecological cleansing and fertilization service of considerable importance to humans. They are sanitation engineers and decomposers par excellence, feeding on and recycling both animal and plant matter. They provide more soil aeration than earthworms. In California native ants play very important roles as seed dispersers for native plants and as a food source for native lizards.

Around 270 species of ants exist in California, but fewer than a dozen are considered important pests. Note that of those 270 species, 25 of them or 10 % are introduced from somewhere else.

The main exotic species in California are

Argentine ant (*Linepithema humile*)

Red imported fire ant (*Solenopsis invicta*) in Southern California

Crazy ant (*Paratrechina longicornis*)

(These first 3 are invasive species)

Pharaoh (*Monomorium pharaonis*)

White footed ant (*Technomyrmex albipes*)

Pavement ant (*Tetramorium caespitum*)

(These last 3 are tramp species)

Ants are social insects and live in colonies. The colony is divided into 3 different castes, workers, queens, and males. The workers are sterile females and they enlarge and repair the nest, forage for food, care for the young and queen, and defend the colony. Queens lay eggs and sometimes participate in grooming and feeding larvae. Males serve only to mate with the queens.

Ants pass through 4 stages of development: egg, larva, pupa, and adult. Queens mate with males and lay eggs that hatch into legless larvae. The larvae are fed and cared for by worker ants. At the end of the larval stage, they turn into pupae that do not feed. Eventually the adult ants we recognize emerge from the pupal cases.

2. Identification

The Argentine ant is light to dark brown, around 3/32 to 1/8 inch (2.2-2.8 mm) with a single erect node on its waist and a bulge on its thorax. If one ant is crushed it has little smell, but if a large number of ants are crushed, there is a musty smell. This is different from the rotten coconut odor of a crushed odorous house ant.

The Argentine ant is a nuisance pest that frequently invades houses searching for sweets and protein. Argentine ants will feed on just about anything from sweet cereals to dead insects and human vomit and sputum. Outside, the Argentine ant protects Homopteran insects (e.g. aphids, scales, mealybugs) from their natural enemies so the ant can have a steady supply of one of its favorite foods, honeydew excreted by these insects. By protecting Homopterans, the Argentine ant interferes with the parasites and predators that might otherwise control these insects if the ant were absent.

When populations of honeydew-producing insects decline in late summer, Argentine ants invade structures looking for food and sometimes water. Again in winter ants may invade looking for food or dry places for nests.

3. Biology and Management

Biology

General

- The Argentine ant is not native to the U.S. It probably came on Brazilian coffee ships to New Orleans in the late 1800's.
- In 1918, J.R. Horton wrote in a USDA Bulletin that they had trapped 1.3 million queens and collected 1,000 gallons of brood.
- This ant was first found in California in 1905, in Ontario. By 1908 it had spread through the citrus growing regions of the state to San Francisco.
- This ant does not sting but will occasionally bite.
- Seasonal colony cycle:
 - Workers are produced March through October. For the most part, ants remain outside feeding on honeydew.
 - Colonies grow through spring and summer.
 - At the end of the summer when Homopteran populations decline, ant begin foraging for alternative food sources in nearby buildings.
 - Massive die-off from mid-October to November
 - In the wettest part of the year, ants often invade structures looking for dry places to nest, and sometimes for food.
- Argentine ants may be capable of carrying pathogenic bacteria in hospitals and food establishments.

Colonies

- The Argentine ant lives in colonies that are linked by tunnels, and Argentine ant workers move freely from nest to nest. Each colony has many queens that live in harmony. It may be more accurate to think of Argentine ants as living in huge colonies with 1000's of entrances. Some researchers consider the Argentine ants from San Diego to the Eureka to be one vast colony.

- Because of these immense “supercolonies,” the concept of finding and killing “the” nest is not always valid.
- Argentine ants do not have to defend their colonies from other Argentine ants, so the energy that would have been spent on defense is channeled into making more ants. This ant out-competes other ants and saturates the environment.
- Argentine ant queens are not just egg-laying machines, they feed and clean themselves and help care for the young. Queens can be seen walking in foraging trails (they are much larger than the workers).

Feeding Behavior and Navigation

- Worker ants (all females) feed and care for the young, but they also feed each other. Adult ants feed only on liquids, but they collect solid food for larvae. Larvae digest the solid food and produce liquids for the workers to feed on.
- Up to 50% of the food workers ingest is shared with fellow workers. The technical term for insects exchanging food with one another is **trophallaxis**.
- Because of trophallaxis, ant baits can affect a much larger number of ants than just those in the foraging trail that encounter and feed on the bait. On average at any one time, only about 10% of the ants in a colony are out foraging.
- Some ant species lay down a pheromone trail on their way back to the nest after they have found food. Argentine ants lay down a pheromone trail both as they are searching and when they are returning to the nest with food. Researchers believe this is a strategy to improve the efficiency of their foraging by marking areas that have already been searched.
- Sun and polarized light are important cues for navigation. Argentine ants also use gravity and move along edges, grooves, wires, pipes. They have a good sense of smell, but their visual acuity is probably not that great. Ease of navigation has a lot to do with their chosen path.
- Argentine ants will feed on just about anything from dead animals (including insects) to all kinds of human and pet food, to vomit, feces, and even human sputum.
- As mentioned before, a favorite food of this ant is the honeydew produced by insects like aphids, mealybugs, scales, and whiteflies. Plants that harbor these pests and are growing near a structure will attract ants to the building.
- The Argentine ant will forage 200 ft. away from the nest.
- Liquid baits with sugar, as the attractant are useful throughout the year, because adult ants will always feed on sugary liquids. Baits with a protein attractant may only be useful in spring when the colony is expanding and ants are feeding a large number of young.

Nesting sites

- Outside, nests are shallow and in the open where there is some moisture.
- Argentine ants are very mobile and can move their colonies in hours to take advantage of a food source or to escape inhospitable conditions. In winter they look for places that are warmer and drier than the surrounding area, and in summer they seek cooler and moister sites.
- They nest primarily in the ground, but they can be found nesting in unusual places including inside metal curtain rods, under tiles on kitchen counters, in wall voids, in soil accumulated in the corners of a roof, damp areas under leaking roofs, in damp walls, and in vehicles such as cars, buses, mobile lunch vehicles, and motor homes.

Landscape factors that favor the Argentine ant

- Damp and/or disturbed soil
- Soil in potted plants
- Mulch such as shredded bark, pebbles, small stones
- Vegetation that supports honeydew-producing insects such as citrus, pines, bottlebrush, birch
- Soil that is kept warm by the thermal mass of a sidewalk, flagstone walk or patio, decorative rock on top of black plastic

Hands-on Exercise #1—Identifying Ants

Goals: to introduce students to using a microscope and to using a key to identify an insect

1. Divide class into groups according to how many microscopes are available.
2. Pass out a set of specimens (vials #1, #2, #3) to each group along with a scope, a set of dishes, and a probe.
3. Make sure each group understands how the scope works. Ask them to try focusing on a pencil or pen tip to practice.
4. Connect computer to <http://www.ipm.ucdavis.edu/TOOLS/ANTKEY/> and project the key onto the screen for class to see.
5. Ask class to put 2 or 3 specimens from vial #1 on a dish and focus it under the scope.
6. Lead the class through the key making sure that everyone understands the features.
7. Repeat the process with the other 2 vials.

Management

Regularly scheduled perimeter pesticide treatments are not part of an IPM program. An IPM program views the need to regularly apply pesticides as an indicator that the program is not working efficiently and seeks other solutions in order to reduce pesticide use.

1. **Gather background information.** Begin with the customer's call to the office.
 - a. Where do they live/where is the structure?
 - b. Type of house/building?
 - c. Where do they see ants?
 - d. How long have they had the problem?
 - e. Is there something that happened or that the customer did that might relate to the ants being a problem now?
 - f. Have they recently brought in new potted plants or potted plants from outside?
 - g. Have they treated it themselves? How or with what?
 - h. Do they have children? (crumbs, food in places other than kitchen) Pets? (dog food, cat food left out)
 - i. How old is the house/building?
 - i. New house—more cracks, shoddy construction
 - ii. Old house—can also have many holes
 - j. Do they have ants all year around? If not, when do they see them?

2. Thoroughly inspect the site

- a. Ant nests evident? Ant trails evident? Is it possible to follow the ant trails back to a nest?
To where they are entering the structure?
- b. Potted plants next to structure?
- c. Bushes and/or trees touching structure?
- d. Gutters full of leaves? Debris on roof?
- e. Plants with honeydew-producing insects or extra-floral nectaries? (esp. citrus, roses, pines, birches, black acacia, bottlebrush, tomatoes, cabbage family plants)
- f. Plastic covering ground with wood chips or decorative rock on top?
- g. Garbage cans next to structure? Garbage cans dirty?
- h. Woodpile next to house?
- i. Pets being fed outside? Pet food left out, either inside or outside
- j. BBQ dirty?
- k. Leaking faucets or leaking irrigation?
- l. Irrigation wetting walls of structure?
- m. Other areas of high humidity?
- n. Broken screens?
- o. Faulty seals around doors or windows?
- p. Holes in walls for pipes or wires?
- q. Ants coming from neighbors' yards?
- r. Condition of food preparation and eating areas inside: clean? dry?
- s. Food stored correctly inside?
- t. Food garbage removed before nightfall or garbage bags secured overnight?
- u. Ant trails evident inside?
- v. Is it possible to follow ant trails back to entry points?

3. Establish the pest treatment threshold with the customer

- a. Get clues from initial talk on the phone
- b. It may be necessary to try to change the customer's threshold upward
- c. Pest management professional (PMP) can say it is possible to have 80% control outside, but it is not possible to guarantee no ants outside.
- d. It is impossible to guarantee ants will never again come into the structure.
- e. If customer asks for not a single ant ever again, explain that this will be very expensive and entail sealing the whole house and baiting away from the house. Can't guarantee ants will never be back, but can guarantee that the PMP will be back if the ants come again.

4. Develop an IPM Plan

- a. An IPM program will consist of a number of elements: habitat modification, sanitation, exclusion, physical controls, and chemical controls. Baits are the ideal chemical control for a number of reasons: very little active ingredient is used compared to perimeter sprays, they are more effective because foraging ants take bait back to the colony to share directly with nest mates, baits can be contained in tamper-resistant stations to prevent exposure of people, children, and pets, and baits contained in bait stations are unlikely to wash away and cause surface water pollution.
- b. It is very important to keep records of what is done—not only of the amount and type of pesticide used, but other physical, mechanical and biological treatments along with

- preventive measures, exclusion, and sanitation. This information can be very useful in reviewing the IPM program with the customer and for remembering exactly what worked and what didn't.
- c. For an Argentine ant problem, the first step is to get rid of the ants inside.
 - i. Trace any ant trails as far back as possible. Try to find the entry point into the structure. Caulk all entry points that can be found.
 - ii. Wipe up ant trails with soap and water, vacuum them up, or use a lint roller to pick them up.
 - iii. Remove and clean up food sources.
 - iv. In general, it is preferable to bait ants outside because baiting inside can exacerbate the problem by drawing more ants into the structure (see below under baiting for more specific information on how to bait); however,
 - o In winter, the PMP may need to bait inside briefly to eliminate the trailing ants.
 - o In summer, the PMP can bait inside for one day and then move bait outside.
 - d. The next step is pest proofing
 - i. Look outside to find trails leading into the house. Caulk any exterior entry points.
 - ii. At least caulk areas where ants have been seen
 - iii. Blow diatomaceous earth into wall voids.
 - e. Itemize other things that need to be done and affix a cost to each item—discuss with the customer which items the PMP will handle, which the customer will handle, and which will be contracted out.
 - i. Sanitation
 - o Garbage must be managed properly and garbage areas and containers kept clean.
 - o Cans and bottles must be thoroughly cleaned before storing for recycling.
 - o Food must be stored in ant-proof containers—plastic or metal with tight fitting lids or screw-top glass jars (jars are not ant-proof unless the lid has a rubber gasket).
 - o In offices, personal snacks must be stored in ant-proof containers.
 - o Food preparation and eating areas must be cleaned daily.
 - o Large appliances in commercial kitchens should be regularly steam cleaned.
 - o Note that in a residential setting, cleanliness is most important in late summer and mid winter. At other times, residents may be able to relax somewhat.
 - ii. Habitat modification
 - o Honeydew-producing insects on vegetation near the structure should be controlled by water washing plants and using sticky barriers around trunks or by removing plants.
 - o Trees, bushes, vines, and other vegetation should be cut back to at least 18 inches away from the structure.
 - o Leaking pipes and irrigation must be repaired
 - o Any areas of excessive moisture should be remedied. Irrigation water should not touch the structure.

- iii. Exclusion and structural repairs (physical controls)
 - Cracks and crevices should be caulked. This does not have to be done all at once. Start where ants usually get in and where ants are or have been seen. Whenever ants find a new avenue into the house, caulk the hole. Over time there will be fewer and fewer ways for ants to get in.
 - Gaps around pipes, cables, and wires that pass through walls should be filled both inside and outside the structure.
 - Doors and windows should have weatherstripping. Window should have screens and screens that are in good condition.
 - There may be other building repairs to fix conditions conducive to ant invasions.
- iv. Baiting

Baiting should be used alongside the preceding strategies, not as a stand-alone strategy.

Why Baits Work

- Baits work because worker ants feed them to queens and young (larvae) and share them with each other (trophallaxis).
- Baits must have delayed toxic effects so that workers can thoroughly and uniformly share the bait throughout the colony by trophallaxis.

Which Baits Do Argentine Ants Like Best?

- Protein baits are taken best in the spring and early summer when there are many larvae to feed in the colony. Workers cannot ingest solid baits so in order to be digested and made available to the colony they must first be fed to larvae.
- Liquid sugar baits are taken all year round and can be ingested by workers. Liquid sugar baits are also fed to queens and larvae.
- Argentine ants will feed on gel baits, but not as efficiently as on liquid baits.
- Argentine ants are selective when feeding on granular baits. They prefer particles between 840 and 1000 micrometers. Being small ants, Argentine ants will feed more efficiently on small granules.

Use a Bait Station with Granular or Liquid Baits

- Using bait stations, either for granular or liquid baits, reduces the amount of insecticide used, reduces the impact on non-target species, and reduces the possibility of contaminating water run-off (broadcast baits can be washed into the gutter by water and blown into the gutter by wind or landscape maintenance equipment).
- Research has found there is no advantage to scattering granular baits rather than putting them in a bait station.
- Gel baits can be used on vertical surfaces and in cracks and crevices. Make sure they are protected from weather and are not accessible to people, children and pets.

The Concentration of Active Ingredient in the Bait is Very Important

- Too much active ingredient (in other words, insecticide) in a bait can repel worker ants or kill them before they have a chance to share much, if any, with the colony.
 - i. For a boric acid, borax, or borate bait, the concentration of active ingredient that will be most effective in killing the colony rather than just stopping the ant trail is between 0.5 and 2%. Higher concentrations may be used to quickly eliminate ants indoors.
 - ii. Commercial boric acid, borax, or borate baits can be diluted to achieve this concentration.
 - iii. The optimum sugar concentration is 25%.
 - iv. When you dilute a liquid bait, you need to fortify the sugar content (DPR says this is legal as long as you are not re-selling the mixed bait). To ensure adequate amounts dilute the bait with 25% sugar water.
- As the insecticidal activity in a bait increases, feeding on the bait decreases. This is true for all insecticides including borates and other toxicants.
 - i. If the concentration of the active ingredient is too low, ants will readily consume the bait, but it will not kill them.
 - ii. An Argentine ant typically feeds 4 to 12 other ants, so in this process, a liquid bait with too little active ingredient could be diluted to the point where it is no longer effective.
 - iii. If the concentration of active ingredient is too high, it will kill ants before they can spread it to the colony, or they will refuse to feed on it at all.
 - iv. Evaporation from a bait station could increase the active ingredient to the point where it is too highly concentrated to be effective.
- Research suggests that liquid baits containing boric acid may need to be provided for several weeks to be most effective. *However, this does not mean that liquid baits cannot work if they are used for a shorter amount of time because it depends on the degree of infestation. It may not take as long to have a substantial impact on a light infestation.*

Locate Bait Stations Properly

- In general it is best to bait for ants outside the structure. This is because it may take a number of weeks to eliminate a colony, and you don't want to be continually attracting trails of ants into a structure.
- A liquid bait with a high concentration (greater than 4%) of boric acid, borax, or borate can be used indoors to eliminate an ant invasion within a few days.

- i. This is something a customer can do while waiting for a visit from a technician.
- ii. Indoor bait stations should be placed in an out of the way spot, but on the ant trail.
- iii. A bait station inside should be removed as soon as the trail disappears. Leaving it longer may attract more ants to the spot.
- Do not spray ant bait stations with pesticide; it will repel the ants.
- Do not locate ant bait stations near areas that have recently been sprayed with pesticide or that are likely to be sprayed with pesticide in the future.
- Outside, place bait stations out of direct sunlight. This will reduce evaporation, and prevent the bait from becoming too hot for the ants to feed on.
- Place bait stations where ants are seen trailing.
- Place bait stations near sources of moisture.
- Bait stations can initially be placed close to the structure and then gradually moved farther away toward the property line.

Use Enough Bait Stations

The number of bait stations used should be based on the size of the structure and degree of infestation. Bait stations should have at least a 200 ml capacity. The following guidelines are suggestions for using a liquid bait delivery system with a 500 ml capacity.

- Use at least 2 bait stations for a structure of 1500 sq. ft. and place them on either side of the structure.
 - For larger structures, use the following guidelines (measurements are for ground floor only):
 - i. Up to 1900 sq. ft.—up to 4 units
 - ii. 1901 to 2999 sq. ft.—6 units
 - iii. 3000 to 5000 sq. ft.—8 units
 - For severe ant problems, it may be necessary to place additional bait stations around the perimeter of the property:
 - i. Up to 1 acre lot size—4 units
 - ii. Greater than one acre—2 units for each adjoining acre
- f. If customer can't afford to do all that is recommended, the PMP can suggest doing a little every month.
- g. Start the customer with 3 visits in one month, after that, it depends on the situation whether visits will be monthly, quarterly or yearly. Note that bait stations must be checked the day after they are put out.

5. **Establish on-going communication with customer**
 - a. Offer knowledge and sell expertise
 - b. Explain findings from the inspection
 - c. Recommend sanitation measures and help the customer to make a housekeeping schedule
 - d. Recommend pest proofing measures
 - e. Recommend habitat modification measures
 - f. Recommend horticultural controls such as trimming trees and bushes, moving plants away from house
 - g. Discuss with customer their responsibilities in the ant management program and make sure they understand the program will not work well without them doing their part.
 - h. Explain how ant bait stations work
 - i. May be more ants at first
 - ii. Don't touch bait station, don't spray bait station
 - iii. If ants go beyond bait station into house, clean up with soap and water
 - i. Ask customer to keep PMP informed of what is happening with the ant problem
 - j. Methods of communicating with customer
 - i. Phone calls
 - ii. Reports
 - iii. Newsletters
 - iv. Letters to residential customers
 - v. Leave-behind information pieces
 - k. Call-backs can be a chance to do extra communication with customer
6. **Evaluate program**
 - a. Goal—to keep ants out of house 90% of the time
 - b. Need to keep records of what happens over time to remember what was done and what worked and what didn't
 - c. Is the customer happy?
 - d. Need to evaluate customer—is s/he worth keeping?
 - e. Are things working? If not, do something right away.
7. **Provide quality assurance**
 - a. Stay in touch with customers—how are things going?
 - b. Record feedback from customers

Hands-on Exercise #2—Observing Ant Bait Stations at Work

Note: This exercise can be used at a convenient time to break up the preceding lecture and discussion on management.

Goal: To show students the effectiveness of liquid boron-based baits in bait stations by comparing the number of ants entering a bait station with 25% sucrose water on one side of a building to the number of ants entering bait stations containing liquid baits on the opposite side of the building after a week.

Set up for exercise

1. Obtain permission from site manager at building where class will be held and alert maintenance staff so bait stations will not be disturbed.

2. Label each bait station in accordance with California law (include active ingredient, generic name of pesticide, signal word from the label, and name and contact information for responsible party)
3. At least a week before the class, place ant bait stations on opposite sides of the building the class will be held in.
 - Discuss placement with maintenance staff to avoid conflict with maintenance activities and to determine where ants are usually found.
 - Place 1 bait station with sugar water on one side, 2 to 3 baited stations on the other. Ideally, the sugar water station should be at least 200 ft. away from the baited stations.
 - In winter, it may be useful to first fill all bait stations with sugar water until ants are steadily feeding and then replace the sugar water with liquid baits.
 - Locate bait stations away from public view, hidden by shrubbery or other objects.
4. Check bait stations the next day to make sure ants have found them. Make note of the kind of activity at each bait station to relay to students. If all stations contain sugar water, this is the time to replace the sugar water with liquid bait on one side of the building.
5. If this class is part of a series of IPM trainings held over a few weeks, this exercise can be done over a longer period of time. Put the bait stations out before the first session with only sugar water. Have student observe stations during lunch at the first session. A week before the Ant IPM class, replace the sugar water with bait on one side of the building and proceed with exercise. Keep all stations filled throughout the training series and have students observe stations at least one more time.

Instructions for exercise

1. Divide class into 2 groups.
2. Send one group to look at sugar water stations and walk with one group to look at the bait stations.
3. Discuss with student what you see and have them switch places.
4. If class is small, it may not be necessary to divide it into 2 groups.

Hands-on Exercise #3—IPM Plan for a Residential Community

Time needed: allow at least 1 hour

Instructions for Instructor: Divide class into groups of 4 to 6 and pass out Assignment, below along with the photos of the community, also below. Explain the exercise and that they are to work together in groups with one person as the scribe. It will be helpful to verbally relate the situation described below, because they may not have enough time to read it all. At the end of 30 minute, choose one group to explain their “IPM Action Plan” and allow other groups to add or question as they go along.

Assignment: IPM Action Plan for Argentine Ant Management

Definition: Integrated Pest Management (IPM) is a decision-making process that uses regular monitoring and record keeping to determine if, when, where and what treatments are needed to prevent or solve pest problems. Educational, legal/regulatory, habitat modification, horticultural, biological, mechanical, and chemical methods might be used to keep pest numbers low enough to prevent unacceptable nuisance, economic damage, or injury & disease. The IPM approach emphasizes long-term pest prevention, using a site-specific combination of environmentally friendly, cost-effective strategies.

Instructions:

- 1. Your group will prepare an "IPM Action Plan" that addresses the various problems described in the background notes. The objective of this exercise is to gain experience using the IPM decision-making process to design a long-term solution to an ant problem.*
- 2. Select one person to record your discussion and to describe your group's IPM Action Plan to all workshop participants.*
- 3. Your group has 30 minutes to develop your IPM Action Plan by answering the questions on pages 4 and 5.*

Background on Argentine Ant Problem in a Residential Community

For the professional pest management operator there is no client more challenging to satisfy than a residential community association. Whether the association consists of multi-family residences, individual homes, or both; the reasons are generally the same. They conduct business more like small governments and corporations. An elected board of directors serves and represents the resident members. The residents of these communities have chosen this lifestyle to free themselves from most of the chores, upkeep and maintenance responsibilities that come with independent home ownership.

For our example, we will use an actual community nestled (as they describe it) in the foothills of Santa Barbara.

Types of structures and facilities on the property (see also accompanying photos):

- 18 single-family residences (patio homes)

- 3 large eight-unit condominiums.
- a clubhouse,
- separate pool area
- two tennis courts.

Homeowner associations

This Santa Barbara community actually has three associations:

1. The 18 patio homes form one.
2. The 3 condominiums form the second.
3. Both 1& 2 belong to a master association.

They were formed in this manner to balance out property values and operating expenses proportionate to individual member ownership. The owners of the patio homes have to pay the master association their calculated share of expenses due for the common grounds, pool, tennis courts, clubhouse, taxes, etc. Their individual lots with homes were not included in the master association's pest management agreements. They could purchase services as a group if agreed upon within their association, or separately as individual property owners.

Pest control history

Many Pest Control Companies Hired and Fired

When it was built in the early 1990's, the community acquired pest control services to treat the perimeter and grounds around the buildings. Periodically the board fired and hired a number of pest management companies, not necessarily because of their performance. Usually one or more complaints by residents was sufficient to initiate an opportunity for board members to open bids for a cheaper service offering fresh solutions. Meanwhile, as the trees, ground cover and shrubs matured, structural ant invasions became larger and more frequent. (Photos show the significant amount of foliage and flowering ground cover.)

Argentine Ants Proliferate

As the Argentine ants proliferated, the level of activity reached a point where relaxing at the pool with or without a beverage and snack was an open invitation for the ants to investigate. One resident claimed his suntan lotion was an ant favorite. Electrical equipment in the pool pump room was ruined and association parties at the clubhouse were becoming unbearable. Home invasions were a continuous problem, with the ants trailing through windows and nesting in wall voids.

Chemically Sensitive Resident

There was also an issue with a chemically sensitive association member claiming ill effects from the products being applied. Whether the individual was affected or not, she was not notified of pending services prior to the time of application. Pest management personnel simply avoided treating near her unit. In fact, they would make every effort to perform the services without drawing her attention to their presence. As in most situations where an individual has a strong aversion to a particular procedure, she did her best to seek the service providers out to make her objections known. The technicians could depart when their work was completed. The board of directors and her neighbors bore the brunt of her ever-increasing frustration.

Residents Perform Their Own Pest Control

To deal with the Argentine ant issue, the board of directors called a meeting for all members to attend. During the meeting it was decided they as a group would first gather research on the Argentine ants and share it. Secondly, members would form a pest control team of their own to treat the problem. Their rationale was based on the power of the Internet providing them with information and the necessary products. In the excitement accompanying the solution and the projection of all the money they were going to save, no thought was allocated to liability and safety. The self-treatment program bombed. Between spraying pesticides outside and baiting inside they managed to escalate the problem several fold.

March 14, 2003

In March 2003 the newly elected board of directors, acting on a recommendation from their management company representative, decided to investigate a new pest management methodology. They invited a pest management specialist (Inspector) to take a look at their Argentine ant problem.

In April 2003 the Inspector met with board members and the representative of their management company. The Inspector first requested and received the preceding background history of their pest control.

Inspection of the Grounds

The Inspector probed the base of shrubs, the boots of palms, examined flowers and bulbs, the outer perimeter of the property, midway in and up, near and around several of the buildings.

- a. The community was landscaped with a diverse variety of trees, flowering plants and shrubs with some drought-tolerant vegetation mixed in with plants with high water needs.
- b. The grounds were well-irrigated.
- c. A number of the plants and trees were supporting honeydew-producing insects.
- d. Grassy open areas with streets comprised less than 40% of the community's total surface area.
- e. The grounds, trees and shrubs were all well-groomed, but because the vegetation had matured, it was touching and overhanging structures in numerous places.
- f. Ground covers and shrubs had grown and filled in providing shady, moist habitat for Argentine ants and cover for rodents.
- g. Other than a few homes below in a valley near its west side, the community was completely surrounded by arid land.
- h. There were holes around pipes leading into structures and windows and door had cracks or openings that would admit Argentine ants.

Information from the Maintenance Man

The Inspector requested that the association's on-site maintenance man accompany him around a couple of the buildings and the pool area. (People make observations from their perspective. Together these observations add up to a much more holistic picture of the past. More importantly, they offer a fair idea of what can really be accomplished in the future.)

- a. The Inspector learned from the maintenance man that whenever he began working on repair projects to resolve small structural issues, he was continually interrupted and sent on various other chores by the association members.

The Dumpster

- a. The garbage was being removed once a week.
- b. The dumpster was located directly behind the pool house and was in full sun 70% of the day.
- c. Not all community members were using plastic bags for their garbage.
- d. The dumpster was filthy and had a thick layer of sweet, sticky goo on the bottom.
- e. Enormous numbers of ants were trailing into the dumpster.

Interior Inspections

Inspections were conducted of the interior of the corner apartment in each of the large buildings and in one of the patio homes. Nothing unusual was found.

Chemically Sensitive Resident

One of the residences inspected belonged to the association member who complained of chemical sensitivity.

- a. She was baiting with liquid baits inside her home and ants were trailing up onto a stoop and into her apartment where the door's rubber stripping was worn and hard.
- b. Her home was on the edge of the community and backed up against the wildland hill. When technicians came to spray the perimeter of the community, they did not notify her, and pesticide had frequently drifted in through her open windows.

“I live on the very west side of small mountain just a few miles from the Pacific and I have to keep my windows closed because people will not extend a simple courtesy and inform me in advance as to when they plan to spray.”
- c. The resident felt, with justification, that the pest control companies were not listening to her and that the Board and her neighbors had begun to ignore her.

Report

A list of observations and recommendations was presented to the Board.



Entry to Residential Community in Santa Barbara



Overgrown Landscaping in a Santa Barbara Residential Community

IPM Action Plan Summary Sheet A

Your pest management objective for this site is long-term management of the Argentine ant that is affordable by the homeowner association.

1. Treatment Thresholds

How many different treatment thresholds will there be for this property and where will they be?

What will the threshold be in each of the areas you listed above (low, medium, high)? (A low threshold means a low number of ants will trigger treatment actions.)

2. How will you deal with the chemically sensitive resident?

3. What can you do to help residents deal with ant emergencies when you are not around? (e.g. advice you can give them, products you can suggest or give to them)

4. Describe all the intervention methods you can think of that could reduce the ant problems to a level below the treatment threshold. List them under their categories in (a) through (e) below.

Some interventions can be completed by you, some by the client (residents or maintenance staff), and some may have to be contracted out.

a. Habitat Modification (e.g., sanitation, housekeeping, storage practices)

What can you do and what suggestions can you offer that will help ensure that habitat modifications are made?

b. Horticultural (e.g., change maintenance schedule, remove problem plants, etc.)

How would you prioritize the horticultural issues?

What recommendations do you have for dealing with what looks like a large amount of needed pruning?

IPM Action Plan Summary Sheet B

c. Physical (e.g., vacuuming, caulking)

d. Chemical

e. Other

5. What ideas do you have for helping the maintenance man with his problem of being interrupted constantly?
6. How does your plan prevent possible surface water contamination with pesticide?
7. Which people will you need to educate in order to be successful in implementing your IPM plan?

How will you educate them?

What do they need to know or what will they need to understand?

What written materials would you like to be able to give these clients?

7. How will you monitor and document the success or failure of your treatment program for the Board of Directors?

**Class Exam for Structural Pest Control Board
Argentine Ant Session Exam**

Name _____

1. True or False? Ant baits should contain fast-acting insecticides so that they do not interfere with recruitment.
2. True or False? Colonies of Argentine ants will readily exchange adult workers, brood, and resources.
3. True or False? The number of nodes on the petiole of an ant is an important character for identification.
4. In nature, what is the Argentine ant's primary food source? _____
5. True or False? The size of an Argentine ant colony is constant throughout the year.
6. Why are Argentine ants so successful? _____
7. Circle all the characteristics that will help you tell the difference between an odorous house and an Argentine ant.
 - a. An Argentine ant has a ring of hairs around the tip of its abdomen.
 - b. An odorous house ant has a rotten coconut odor when smashed.
 - c. An Argentine ant has a distinct node on its petiole.
 - d. An odorous house ant has a 3-segmented antennal club.
 - e. An Argentine ant has a noticeable bulge on its thorax.
8. What concentration of sugar water should you use to dilute a borate-based liquid bait to an acceptable percentage of active ingredient? _____
9. What is the function of the pheromone odor trail in ants?
10. True or False? You are more likely to find an Argentine ant nest in a moist shaded spot in December.

Ant Session Exam Answers

1. False
2. True
3. True
4. Honeydew
5. False
6. They are cooperative and don't spend a lot of energy on fighting and defense.
7. b, c, e
8. 25%
9. It is used to recruit nest mates to exploit a resource
10. F

Class Handouts

Handout 1

Important Biological Facts about the ARGENTINE ANT (*Linepithema humile*)

General

- The Argentine ant is not native to the U.S. It probably came on Brazilian coffee ships to New Orleans in the late 1800's.
- This ant does not sting but will occasionally bite.
- Argentine ants may be capable of carrying pathogenic bacteria in hospitals and food establishments.

Colonies

- This ant lives in colonies that are linked by tunnels, and Argentine ant workers move freely from nest to nest. Each colony has many queens that live in harmony. It may be more accurate to think of Argentine ants as living in huge colonies with 1000's of entrances. Some researchers consider the Argentine ants from San Diego to the Bay Area to be one vast colony.
- Because of these immense "supercolonies," the concept of finding and killing "the" nest is not always valid.
- Argentine ant queens are not just egg-laying machines, they feed and clean themselves and help care for the young. Queens can be seen walking in foraging trails (they are much larger than the workers).

Feeding Behavior

- Worker ants (all females) feed and care for the young, but they also feed each other. Up to 50% of the food they ingest is shared with fellow workers. The technical term for insects exchanging food with one another is **trophallaxis**.
- Because of trophallaxis, ant baits can affect a much larger number of ants than just those in the foraging trail that encounter and feed on the bait. On average at any one time, only about 10% of the ants in a colony are out foraging.
- Argentine ants will feed on just about anything from dead animals (including insects) to all kinds of human and pet food, to vomit, feces, and even human sputum.
- A favorite food of this ant is the honeydew produced by insects like aphids, mealybugs, scales, and whiteflies. Argentine ants protect these insects from their natural enemies. Plants that harbor these pests and are growing near a structure will attract ants to the building.
- Liquid baits with sugar, as the attractant are useful throughout the year, because adult ants will always feed on sugary liquids. Baits with a protein attractant may only be useful when the colony is expanding and ants are feeding a large number of young.

Nesting sites

- Argentine ants are very mobile and can move their colonies in hours to take advantage of a food source or to escape inhospitable conditions. In winter they look for places that are warmer and drier than the surrounding area, and in summer they seek cooler and moister sites.
- They nest primarily in the ground, but they can be found nesting in unusual places including inside metal curtain rods, under tiles on kitchen counters, in wall voids, in soil accumulated in the corners of a roof, and in vehicles such as cars, buses, mobile lunch vehicles, and motor homes.

Handout 2

Summary of ANT Management Techniques Compatible with an IPM Program

Physical/Mechanical Controls

- Exclusion
 - Building repairs
 - Caulk cracks and crevices.
 - Fill gaps around pipes, cables, and wires that pass through walls both inside and outside the structure.
 - Weatherstrip doors and windows.
- Vacuum up ant trails.
- Mop up ant trails with detergents

Sanitation/Habitat Modification

- Inspect landscaping near structures for honeydew-producing insects (aphids, mealybugs, scales, whiteflies). Use sticky barriers on plants, control honeydew-producing insects, or remove plants.
- Store garbage in garbage cans or dumpsters outside the building.
- Remove garbage containing food wastes from building before nightfall.
- Store food in ant-proof containers (screw-top jars are not ant-proof unless lid has a rubber gasket).
- Thoroughly clean cans and bottles before storing for recycling.
- Thoroughly clean food preparation and eating areas daily.
- Regularly steam clean large appliances in commercial kitchens.

Examples of Chemical Controls

PRODUCT	ACTIVE INGREDIENT	NOTES
Cleaning up ant trails		
Detergent and water in spray bottle	Detergent & water	Can be used in mopping solution
Orange Guard, various citrus cleaners	d-limonene	Can be used in mopping solution
Ant Baits		
Advance granular	Abamectin	
Maxforce—granules and bait stations	Hydramethylnon/fipronil	Fipronil gives quicker kill
Niban (granules)	Boric acid	Slow acting
Terro (liquid)	5.4% Borax	Slow acting
Drax gel, Drax Liquidator (liquid)	1% Boric acid	Slow acting
Dust (use in wall voids and cracks and crevices)		
Concern	Diatomaceous Earth (D.E.)	
Drione	Silica gel + pyrethrin	
Tri-Die	Silica gel + pyrethrin	
Timbor	Borate	May be less effective than D.E.
Perma-Dust	Boric acid	

Handout 3

Important Notes about Baiting for Argentine Ants

Why Baits Work

- Baits work because worker ants feed them to queens and young (larvae) and share them with each other. (This is called “trophallaxis”.)
- Baits must have delayed toxic effects so that workers can thoroughly and uniformly share the bait throughout the colony by trophallaxis.

Which Baits Do Argentine Ants Like Best?

- Protein baits are taken best in the spring and early summer when there are many larvae to feed in the colony. Workers cannot ingest solid baits so in order to be digested and made available to the colony they must first be fed to larvae.
- Liquid sugar baits are taken all year round and can be ingested by workers. Liquid sugar baits are also fed to queens and larvae.
- Argentine ants will feed on gel baits, but not as efficiently as on liquid baits.
- Argentine ants are selective when feeding on granular baits. They prefer particles between 840 and 1000 micrometers. Being small ants, Argentine ants will feed more efficiently on small granules.

Use a Bait Station with Liquid and Granular Baits

- Using bait stations, either for granular or liquid baits, reduces the amount of insecticide used, reduces the impact on non-target species, and reduces the possibility of contaminating water runoff (broadcasted baits can be washed into the gutter by water and blown into the gutter by wind or landscape maintenance equipment).
- Research has found there is no advantage to scattering granular baits rather than putting them in a bait station.
- Gel baits can be used on vertical surfaces and in cracks and crevices. Make sure they are protected from weather and are not accessible to people, children and pets.

The Concentration of Active Ingredient in the Bait is Very Important

- Too much active ingredient (in other words, insecticide) in a bait can repel worker ants or kill them before they have a chance to share much, if any, with the colony.
 - For a boric acid, borax, or borate bait, the concentration of active ingredient that will be most effective in killing the colony rather than just stopping the ant trail is between 0.5 and 2%. Higher concentrations may be used to quickly eliminate ants indoors.
 - Commercial boric acid, borax, or borate baits can be diluted to achieve this concentration.
 - The optimum sugar concentration is 25%.
 - When you dilute a liquid bait, you need to fortify the sugar content (DPR says this is legal as long as you are not re-selling the mixed bait). To ensure adequate amounts dilute the bait with 25% sugar water.

Baiting for Argentine Ants, cont.

- As the insecticidal activity in a bait increases, feeding on the bait decreases. This is true for all insecticides including borates and other toxicants.
 - If the concentration of the active ingredient is too low, ants will readily consume the bait, but it will not kill them.
 - An Argentine ant typically feeds 4 to 12 other ants, so in this process, a liquid bait with too little active ingredient could be diluted to the point where it is no longer effective.
 - If the concentration of active ingredient is too high, it will kill ants before they can spread it to the colony, or they will refuse to feed on it at all.
 - Evaporation from a bait station could increase the active ingredient to the point where it is too highly concentrated to be effective.
- Research suggests that liquid baits containing boric acid may need to be provided for several weeks to be most effective. *However, this does not mean that liquid baits cannot work if they are used for a shorter amount of time because it depends on the degree of infestation. It may not take as long to have a substantial impact on a light infestation.*

Locate Bait Stations Properly

- In general it is best to bait for ants outside the structure. This is because it may take a number of weeks to eliminate a colony, and you don't want to be continually attracting trails of ants into a structure.
- A liquid bait with a high concentration (greater than 4%) of boric acid, borax, or borate can be used indoors to eliminate an ant invasion within a few days.
 - This is something a customer can do while waiting for a visit from a technician.
 - Indoor bait stations should be placed in an out of the way spot, but on the ant trail.
 - A bait station inside should be removed as soon as the trail disappears. Leaving it longer may attract more ants to the spot.
- Do not spray ant bait stations with pesticide; it will repel the ants.
- Do not locate ant bait stations near areas that have recently been sprayed with pesticide or that are likely to be sprayed with pesticide in the future.
- Outside, place bait stations out of direct sunlight. This will reduce evaporation, and prevent the bait from becoming too hot for the ants to feed on.
- Place bait stations where ants are seen trailing.
- Place bait stations near sources of moisture.
- Bait stations can initially be placed close to the structure and then gradually moved farther away toward the property line.

Baiting for Argentine Ants, cont.

Use Enough Bait Stations The number of bait stations used should be based on the size of the structure and degree of infestation. Bait stations should have at least a 200 ml capacity. The following guidelines are suggestions for using a liquid bait delivery system with a 500 ml capacity.

- Use at least 2 bait stations for a structure of 1500 sq. ft. and place them on either side of the structure.
- For larger structures, use the following guidelines (measurements are for ground floor only):
 - Up to 1900 sq. ft.—up to 4 units
 - 1901 to 2999 sq. ft.—6 units
 - 3000 to 5000 sq. ft.—8 units
- For severe ant problems, it may be necessary to place additional bait stations around the perimeter of the property:
 - Up to 1 acre lot size—4 units
 - Greater than one acre—2 units for each adjoining acre

Sources:

Klotz, J., M. Rust & A. Soeprono. Why delay when you bait & spray? *Pest Control*. April 2004, pp 33-34.

Klotz, J., M. Rust, C. Amrhein & R. Krieger. In Search of the 'Sweet Spot'. *Pest Control*. September 2004, pp 49-51.

Kupfer, K. Guide to Sentinel® System Placement! KMAntPro LLC, P.O. Box 967, Nokomis, FL 34275. 2004.

Reierson, D., M. Rust & J. Klotz. There's Safety in Numbers. *Pest Control*. March 2001, pp 50-52.

Soeprono, A., M. Rust. Strategies for Controlling Argentine Ants (Hymenoptera: Formicidae). *Sociobiology*. 2004. Vol. 44, No. 3, pp 669-682.

References and Resources

Useful Websites for IPM Information

U. C. Davis Ant I.D. Key

<http://www.ipm.ucdavis.edu/TOOLS/ANTKEY/>

This web page has a simple pictorial key for identifying several pest ants found in California.

California Academy of Sciences

<http://www.antweb.org>

This site has a beautiful selection of photographic images of ants found in California

Oregon State University

<http://www.ippc.orst.edu/cicp/>

This is a web site hosted by Oregon State University Integrated Plant Protection Center. The web site is a list of over 6,500 IPM links, organized by topic and searchable by keyword. You can also click on “Main Index” to find categories of links you might be interested in.

IPM Institute

http://www.ipminstitute.org/school_biblio_buildings.htm

This web page lists useful articles about specific pests, and many of the articles are available online.

California Department of Pesticide Regulation

http://www.cdpr.ca.gov/cfdocs/apps/schoolipm/school_ipm_law/26_exempt_text5.pdf

This page of the DPR school IPM web site will help you decide if a pesticide is exempt from posting under the Healthy Schools Act.

University of California Statewide IPM Project

<http://axp.ipm.ucdavis.edu/PMG/selectnewpest.home.html>

Here you will find U.C. Pest Notes for pests of homes, structures, people and pets.

University of California at Riverside Entomology Department

<http://entmuseum.ucr.edu/bugfaq.html>

On this page you will find short descriptions of lesser-known pests with links to sites with more information.

University of Florida Entomology Department

http://creatures.ifas.ufl.edu/main/search_common.htm

“Featured Creatures” has descriptions, biology and some management information on a large number of problem creatures.

University of Florida School IPM

<http://schoolipm.ifas.ufl.edu/>

Useful information on school IPM.

Marin County Department of Agriculture Model School IPM Program

<http://www.co.marin.ca.us/schoolIPM/>

This site has fact sheets to help educate school staff, teachers and parents.

Correspondence Courses

Purdue University Correspondence Course

http://www.entm.purdue.edu/entomology/urban/Urban_Info/courses.html

Here you will find information on Purdue's IPM correspondence courses.

Reference Books and Publications

Urban Entomology by Walter Ebeling

This extremely valuable book is no longer in print, but can be read online at

<http://www.entomology.ucr.edu/ebeling/>

Truman Scientific Guide to Pest Control published by Purdue University

NPMA Field Guide to Structural Pests by Eric H. Smith and Richard C. Whitman, Published 1992

Handbook of Pest Control by Arnold Mallis, Published by Franzak & Foster Co.

Integrated Pest Management for Schools: A How-To Manual (written by BIRC staff)

Find the full text at <http://www.epa.gov/pesticides/ipm/schoolipm/index.html>. Hard copies are available from BIRC (see below).

BIRC publications

For a list of publications on pest management available from BIRC, go to <http://www.birc.org> or call 510-524-2567.

Articles

Why delay when you bait & spray? by Klotz, J., M. Rust & A. Soeprono. *Pest Control*. April 2004, pp 33-34.

In Search of the 'Sweet Spot' by Klotz, J., M. Rust, C. Amrhein & R. Krieger. *Pest Control*. September 2004, pp 49-51.

Guide to Sentinel® System Placement! by Kupfer, K., KMAntPro LLC, P.O. Box 967, Nokomis, FL 34275. 2004.

There's Safety in Numbers by Reiersen, D., M. Rust & J. Klotz. *Pest Control*. March 2001, pp 50-52.

Strategies for Controlling Argentine Ants (Hymenoptera: Formicidae). by Soeprono, A., M. Rust. *Sociobiology*. 2004. Vol. 44, No. 3, pp 669-682.