

# Formosan Subterranean Termites



—Roger E. Gold, Molly Keck, Elizabeth Brown, and Kim Schofield\*

**F**ormosan subterranean termites (*Coptotermes formosanus*) are native to the Pacific Rim in the Far East and were accidentally introduced into the United States. They are considered one of the most aggressive and economically devastating termite species in the world.

Like other subterranean termites, Formosan termites feed on wood and other materials that contain cellulose. They attack and consume a variety of woods at a faster rate than do native subterranean termites. This is partly because their colonies are at least four times as large as those of native subterranean termites. They reproduce rapidly, and a new colony may grow to more than 1 million individuals within 5 years. Formosan subterranean termites also are known to attack living trees, which makes them an important pest in landscapes.

Although they are “subterranean” (underground) in habit, the members of the genus *Coptotermes* regularly construct aerial (above ground) nests within structures that they infest. The possibility of having both a subterranean nest close to an infested structure and an aerial nest within the structure can greatly increase the damage potential of these termites.

## Distribution

The first infestations of Formosan termites in Texas were discovered in 1956 near the Houston Ship Channel in Pasadena, Harris County. It is believed

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that Formosan termites were transported to the U.S. in wooden shoring timbers from the Far East. Formosan termites are now found in at least 30 Texas counties and all major metropolitan areas, and they are spreading to more counties each year.

Homeowners and pest management professionals should watch for isolated infestations of these termites anywhere in Texas. Infested shoring timbers and recycled railroad ties are often taken from docks and railways and used in landscapes to construct terraces and planting beds. This wood is thought to be the primary way the Formosan termite is spreading in Texas. Creosote treatment frequently does not reach the core of these timbers and, by itself, is no guarantee against Formosan termites. These timbers must be properly fumigated to prevent termites from traveling within them and then infesting the soil at a landscaping site.

Other sources of termites are cargo pallets that have rested on infested soil, as well as mulch and sod from infested areas. It is important to limit the spread of Formosan termites because initial infestations in a city can lead to widespread structural infestations.

## Identification

Formosan termites are social insects. Three forms, called castes, are found in the colony—reproductives (winged or wingless), soldiers, and workers (pseudergates). Soldiers and winged reproductives (alates or swarmers) are the castes used for identification purposes. Figure 1 shows the life cycle of these termites.

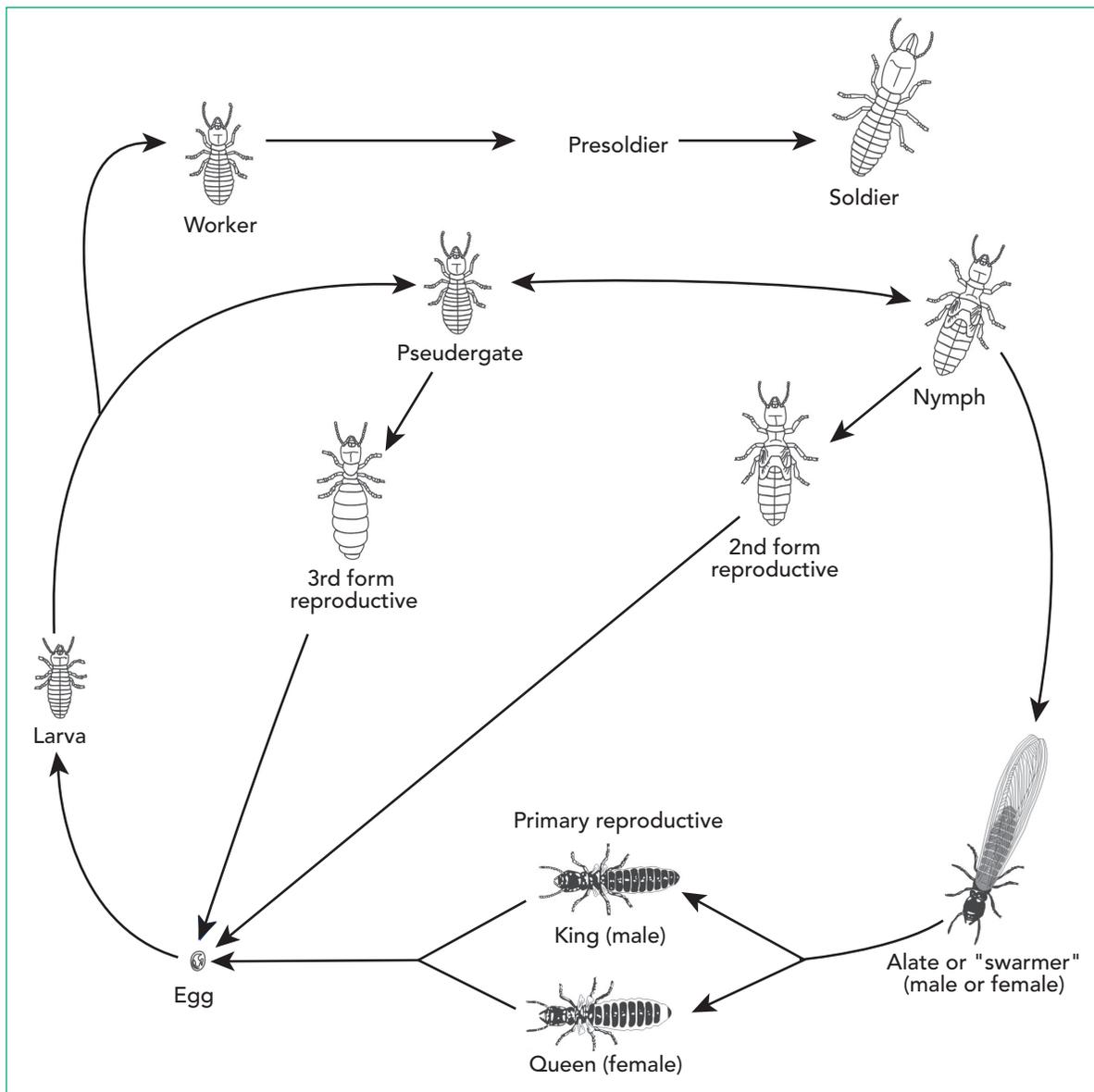


Figure 1. Formosan subterranean termite life cycle.

**Winged reproductives (alates or swarmers):**

Winged Formosan termite reproductives, also called alates or swarmers, are yellowish brown and 12 to 15 mm long (0.5 to 0.6 inch) (Figs. 2a and 2b). They swarm at night from early May through June and are attracted to lights. They have a dense covering of gold to reddish hair (Fig. 2b) on their transparent wings. The outer most veins in the wings are parallel to each other, with few cross veins (Fig. 2a).

Some drywood termites (Fig. 2c) are also a honey brown color and are about the same size as Formosan termites. But their wings are clear, lack hairs, and the outer most veins in the wings have several cross veins (see Texas AgriLife Extension publication E-366, “Drywood Termites”). They, too, swarm at night and are attracted to artificial lights.

Desert (agricultural) termite swarmers (Fig. 2d) are also brown but usually much larger than Formosan termites. Their wings are opaque rather than transparent like subterranean and drywood termites. The veins in the wings are dark and the wings are often crinkled on the ends.

These three groups of termites can be distinguished by features such as veins in the wings and characteristics of the head (Fig. 3). If identification is in doubt, the termites should be submitted for identification to the Center for Urban and Structural Entomology, 2143 TAMU, Department of Entomology, College Station, TX 77843-2143. Additional information can be found at <http://urbanentomology.tamu.edu>, or call (979) 845-5855.

**Soldiers:** A Formosan termite soldier has a head shaped like a tear drop (Fig. 4a, top) and large mandi-

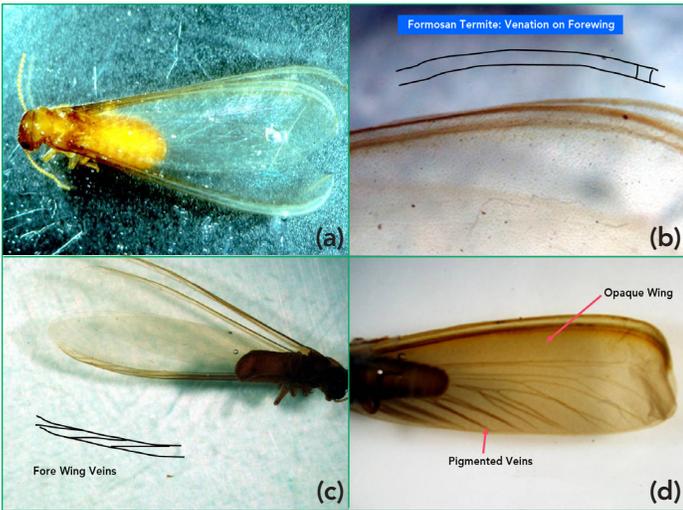


Figure 2. Formosan (a and b), drywood (c), and desert (d) termites.

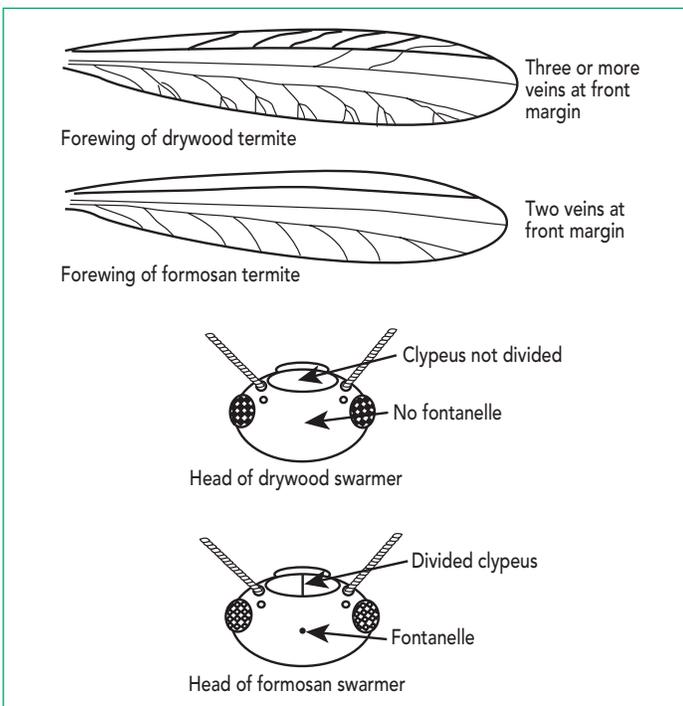


Figure 3. Characteristics of Formosan and drywood termites.

bles (mouth parts). The head of a native subterranean termite is more rectangular (Fig. 4a, bottom) and it has smaller mandibles. Formosan termite soldiers are more aggressive than native subterranean termite soldiers. When disturbed, they secrete a white defensive substance from a gland called the fontanelle, located on the front of the head. The fluid is sticky and helps to disable attackers. They can also attach themselves to a finger (Fig.4b) with their mandibles (mouthparts). The bite and fluid are harmless to humans, but are used, along with head shape, to differentiate Formosan from native subterranean termites.

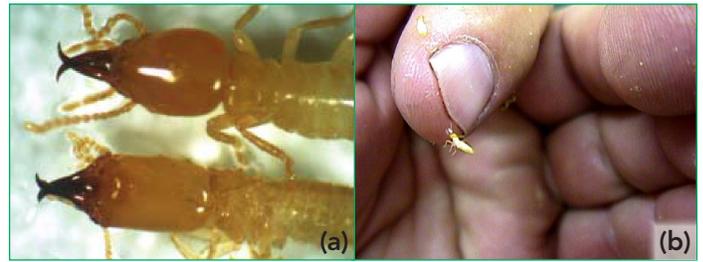


Figure 4. Formosan subterranean termite soldiers.

**Workers (pseudergates):** Workers of Formosan termites are white to off-white in color and are difficult to distinguish from the pseudergates of other termite species (Fig. 5).



Figure 5. Worker and soldier termites.

**Ants and termites:** Although ants often swarm at the same time of year as do termites, it is easy to distinguish them from termites by the shape of their bodies, wings and antennae (Fig. 6). Most ants do not destroy wood, so it is important to be able to tell them apart from termites.

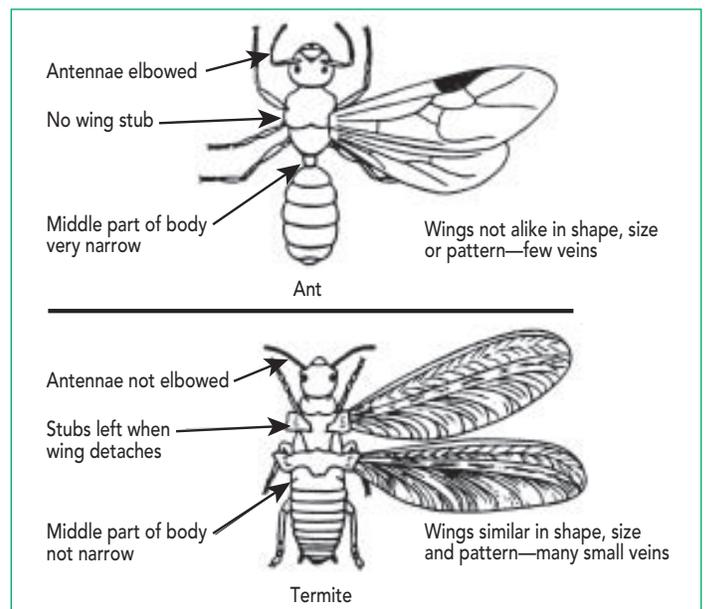


Figure 6. A comparison of an ant (top) and a termite (bottom).

## Biology and habits

Formosan subterranean termites belong to the same family as native subterranean termites (*Rhinotermitidae*). They construct their primary nests in the soil with fecal material and cellulose called “carton” (Fig. 7). When they infest a structure, they can form an aerial nest with this carton in the wall spaces (Fig. 8) if moisture is available. Formosan termites often live for months or even years on the moisture in the carton material while they feed on wood in the above-ground portions of a structure. If the colony is separated from its subterranean nest, this aerial nest can survive and the termites will continue to damage the structure.

When new nests and foraging areas are established, a colony can expand rapidly. Like other termites, Formosan workers feed on wood in structures and also



Figure 9. Formosan termite damage to a tree.

on living plants. They have been known to attack more than 50 tree species, including pecan, citrus, wild cherry, cherry laurel, sweet gum, cedar, willow, wax myrtle, Chinese elm and white oak (Fig. 9). Trees weakened by termite feeding may blow over in strong winds. Although native subterranean termites generally feed on the softer wood produced during spring growth, Formosan termites eat both early- and late-season wood (Fig.10), and thus are more destructive than other species.



Figure 7. Carton nest from Formosan termites.



Figure 10. Formosan subterranean termite damage to early- and late-season wood.



Figure 8. Formosan termite-produced carton nest in a structure.

The damage caused by Formosan termites differs from that of drywood termites. Drywood termites live in wooden structures above ground and leave fecal pellets in their feeding galleries. Formosan termites form mud tubes or carton when they forage into structures. When searching for food and moisture, Formosan termites, like other subterranean termites, may chew through non-cellulose material such as asphalt, plaster, rubber and plastic. Their damage can result in home fires caused by electrical shorts.

## Signs of infestation

The presence of mud shelter tubes, swarmer termites, shed wings, or damaged wood are all signs of a termite infestation. This evidence may be inside, under or around a structure. A good inspection is needed to detect termites as early as possible to prevent continuing damage.

**Swarmers:** One of the most common signs of a termite infestation is the swarming reproductive termites on window sills or near indoor lights. Formosan termites swarm at night and are attracted to lights, while native subterranean termites swarm during the day, usually in the afternoon. The presence of Formosan termite swarms indicates a nearby colony and suggests that they may be attacking a nearby building or tree. Swarmers inside a house are a strong indication of an active infestation in that structure. They are attracted to windows and will leave wings that can be collected and used for identification.

**Shelter tubes:** Shelter tubes constructed of “soil” and rising from the soil up the side of a foundation indicate a possible subterranean termite infestation (Fig. 11). When broken open, active tubes are filled with termite workers and soldiers. These tubes protect the termites from exposure to low humidity and high temperatures, both of which easily kill these fragile insects.



Figure 11. Shelter tube of an active termite colony.

**Damaged wood:** Wood damage is often not apparent to many homeowners, but it indicates that termites are or have been present. Damaged wood may be hidden under a coat of paint; if so, the wood will sound dull or hollow when tapped with a hard object. Wood damaged by Formosan termites resembles wood fed on

by other subterranean termites, in that it will contain soil deposits.

**Nests:** Formosan termites usually build nests in the soil near a wood source, but aerial nests made of carton (chewed wood, soil, saliva and fecal material) are common if moisture is available. Nests can be as large as several cubic feet. Nests in buildings usually are not discovered unless the wall coverings are removed.

Below-ground nests are usually located away from structures and can be difficult to find. More often than not, the evidence of subterranean termites will be mud tubes and foraging tunnels that can be detected during a termite inspection (Fig. 11).

## Management

It is important to reduce the potential for subterranean termite infestation by removing soil-to-wood contact, reducing moisture in and around structures, preventing termite entry, and applying residual liquid chemicals or baits for pre-construction or remedial treatments. Formosan subterranean termite management techniques may differ from those used for other subterranean termite species because of the higher likelihood of aerial nests once the colony becomes established.

## Inspections

A thorough inspection can determine whether there is a termite infestation and damage. It can also determine whether control measures are needed and identify any conditions that encourage termite establishment. Professionals who know the basic construction elements of buildings, the environmental requirements for termite survival, and the behavior of Formosan and other subterranean termites are best suited to perform inspections.

Tools and equipment needed for an inspection may include a flashlight, ice pick or sharp-pointed screwdriver, ladder, and protective clothing (bump cap, coveralls, and rubber knee pads). A clipboard with graph paper and a floor plan/sketch are used to document the findings of the inspection and ensure that the entire structure has been examined. A moisture meter can detect moisture in walls that might indicate conducive conditions, the presence of termite shelter tubes, or hidden carton nests. Termite inspectors may also use fiber optic boroscopes, acoustical detectors, motion detectors, X-ray technologies, infra-red cameras, and methane or CO<sub>2</sub> detectors. This equipment can be useful, but does not guarantee the detection of all termites or their damage to a structure. Some inspectors use specially trained dogs to help find infested areas.

Texas law requires that when an official inspection is made for termites, a State of Texas Wood Destroying Insect (WDI) report be completed. This report is a legal document and must be accurate and complete. The report is based on a “visual inspection,” so the inspector is not required to move furniture or other items that may prevent a thorough inspection, or to inspect areas behind walls, in attics, or in crawl spaces where access is limited. Inaccessible areas must be noted on the form, along with any areas where conditions are “conducive to termites.” Inspectors are not required to state the time for which inspections are valid, though some inspection services guarantee their inspections until specified expiration dates.

The homeowner should shop around to get the best services available in the area, as mistakes can be very costly if an infestation of Formosan termites is not detected.

**Where to check outside.** The inspector should examine the foundation of the house, garage and other structures for shelter tubes coming up from the soil (Fig. 11).

Other areas to check:

- Attached porches, connecting patios, sidewalks, areas near kitchens or bathrooms, and confined or hard-to-see places
- The soil moisture around or under the foundation to determine if faulty grade construction creates moist areas next to the structure
- Areas around windows and door frames and where utilities (such as air conditioning pipes, gas and electric services) enter the structure
- Roof eaves and gutters for defects that might cause leaks and wood rot
- Areas behind closely planted, dense shrubbery or foliage
- Any areas where earth contacts wood, such as fences, stair carriages, deck supports, or trellises

**Where to check inside.** The inspector should check the interior walls for shelter tubes (Fig. 12). A moisture meter is extremely helpful in locating areas where termites or their nests might be hidden in wall spaces and ceilings. Discoloration or staining on walls or ceilings may indicate water leaks that decay wood and attract termites. The inspector should probe door and window facings, baseboards, and hardwood flooring, being careful not to deface finished wood.

Other areas to check:

- Attached, earth-filled porches, known or suspected joints in the concrete slabs or floor, cracks or expansion joints in the foundation, and unusual blistering in paint or wallboard surfaces



Figure 12. Shelter tubes on interior walls.

- Areas where plumbing or utility pipes enter the foundation or flooring by passing through the foundation walls
- The floor covering for raised or split areas
- Plumbing, particularly in bathrooms on slab construction. **The bath trap area should have an access. If there is none, a removable plumbing hatch should be built for periodic inspections (this is not required by law but is important to have).**
- The attic for shelter tubes, water leakage, wood rot, or damaged wood
- Areas underneath or close to earth-filled porches, patios, planters and bathrooms for water leakage and termite damage
- The top of the foundation wall where the floor and the wall intersect
- The inside of beams, chimney bases, hearths, or piers
- The crawl space between the floor and the underlying soil (if the house is of pier and beam construction). Crawl spaces should have a minimum of 18 inches between floor joists and the underlying soil, and at least 12 inches between floor beams. Standing water underneath the house will require remediation, as it is conducive to termite infestation and wood-destroying fungi.

## Preventive measures

Prevention is the best way to manage Formosan termites. The best time to protect against any termite species is before and during construction. The soil beneath and around the foundation should be treated with a liquid insecticide. Insist that the contractor or architect specify the application of the termiticide **before** the slab is poured. This is the one time in the life of a structure when the soil beneath the slab can be protected against

termites. This pre-construction treatment will be effective for several years, but over time the surrounding soil will need to be retreated.

A complete pre-construction treatment must include **all soil** under the slab. In addition, the outside of the structure should be treated after the final soil grade is established. This treatment is imperative, but some pest management companies may list it as an additional treatment and charge to come back out to the structure to complete the pre-construction work. Treating the plumbing penetrations alone is only a partial treatment.

Once the foundation is completed, all form boards and stakes should be removed. There should always be at least 6 inches of exposed foundation between the soil and the bottom edge of any siding material, especially stucco. This will permit a thorough inspection for termite activity. During construction, avoid placing any siding or insulation material in contact with the soil or below the grade of the soil.

Using pressure-treated lumber in critical areas may help prevent termite infestation. Pest management professionals have also commonly recommended borate treatments of framing lumber. Though this may be beneficial, it is not considered a “full” pre-construction treatment. Termite baits have been approved for pre-construction use in Texas (in lieu of a liquid treatment), but this is not a recommended method for protecting structures against termite invasion. The use of wire screening can be effective when it is placed over the slab construction site and clamped around all the plumbing before the slab/floor is poured. These physical barriers can be expensive, but they are very effective if installed correctly and thoroughly.

## Remedial treatment

There are several options for treating Formosan termite infestations, including termiticide barrier treatments, baiting programs, and tent fumigations. These methods may be used alone or in combination.

**Barrier treatments.** These treatments establish a barrier of pesticide-treated soil around the perimeter of the foundation and at the entry points of any electrical or plumbing penetrations through the slab and foundation. Spot treatments of less than 10 square feet or 10 linear feet may not prevent Formosan termites from gaining access elsewhere in the structure. Even a thorough treatment around the perimeter of the foundation, and all plumbing penetrations, may not be successful if termites can enter through hidden cracks in the slab or the foundation. All possible entry points should be

found and treated. In Texas, these treatments are considered “partial” treatments, even though they may be very thorough. The only “full” treatment is done at pre-construction.

Formosan termite colonies are large, and the foragers are persistent about gaining access to wood within structures. All structures should be thoroughly inspected to discover and eliminate moisture sources that termites could use to build aerial nests, and any aerial nests that are found. A moisture meter is a valuable tool for locating moist areas and aerial nests.

**Fumigation.** Fumigation is the use of a toxic gas to penetrate the wooden parts of a structure and kill termites. Only professional pest control specialists are certified and licensed to perform fumigations.

Because no pesticide remains to prevent reinfestation once fumigation is completed, this method must be combined with soil treatments to prevent re-entry of termites from the soil. Before fumigating to control Formosan termites:

1. establish a chemical barrier in the soil around the foundation of the infested structure;
2. treat all entry points such as plumbing penetrations and cracks in the foundation with liquid termiticide; and
3. remove all carton nest material from within the structure.

If the barrier treatment is effective, fumigation may not be needed. That is why the soil treatment must be done first. Before contracting for any termite treatments, review the service agreement carefully to understand the options and the costs involved. Some termite treatment contracts in Texas exclude Formosan termites, so it is important to identify the exact species of termite to be controlled before agreeing to any contract.

**Baits.** Termite baiting systems have recently become available as alternative or supplemental treatments for Formosan termites. Baits contain a food source (such as wood) mixed with a slow-acting insecticide that can kill or disrupt the biology of members of the termite colony. Foraging termites eat the bait and then share it with other termites in the colony. A similar system is used for fire ant control. When using baits, the pest management specialist must actively monitor the bait and the levels of control.

Baits can be highly effective on Formosan termites because they feed aggressively, but the termites must first find and eat the baits. Above-ground baits are placed in contact with mud shelter tubes or in other locations where the termites are actively feeding on wood. Within a few days, the termites should begin to eat bait and trans-

fer it throughout the colony. Baits also may be placed in the soil surrounding the structure, but because termites may not find in-ground baits as easily, this method may require several months to years to be effective.

Termite baits use very little pesticide and take advantage of the normal behavior of termites to transfer the chemical throughout the colony. Pest control specialists understand termite biology and behavior and can install the baits correctly, and then monitor the process through regular visits.

Formosan termites consume wood at a high rate, so baits must be inspected frequently. Bait stations should always contain fresh bait in good condition. As the number of termites declines (after several months), the interval between bait inspections and replacements can usually be extended by carefully following label directions. Each bait product will have specific directions that must be closely followed. Some baiting systems are used in combination with liquid barrier treatments at the point where the termites are entering the building. This dual system addresses both the immediate need to protect the structure from foraging termites and the need to spread the toxicant to the entire colony inside.

Again, review the contract before agreeing to any service for Formosan termite control and determine what the follow-up options are if termites are not controlled by the bait treatment.

## Treatment of infested trees

A tree infested with Formosan termites may be treated to eliminate the infestation and prevent further damage, structural weakness, or death. Infested trees can transfer termites to other structures if the wood is recycled and used as mulch.

Applying termiticides to the tree bark usually will not control Formosan termites, as the infestation is gen-

erally in the heartwood (Fig. 9). To treat a tree, holes must be drilled above the soil line to locate the void area formed by the feeding termites in the non-living heartwood of the trunk. Voids in major limbs and branches must also be located and treated. This may require several exploratory drill holes. An appropriate insecticide must then be injected into the voids. Foam formulations of termiticides are especially effective because they expand to completely fill the void spaces. Even if the termiticide treatments are effective the damage done to the tree may not be overcome. Weakened trees are at risk of dying or falling during high wind.

## Keys to managing Formosan termites

Formosan subterranean termites pose significant risk to Texas homeowners. The termites are spreading to new areas of Texas and will cause more damage over time. It is important to use the proper techniques for managing these termites, including:

- Accurate, positive identification of the soldiers or winged reproductives
- Thorough knowledge of their biology and behavior
- A comprehensive inspection
- An aggressive treatment program
- Meticulous, annual inspections to detect evidence of termite activity
- Preventive measures such as maintaining a gap between soil grade and building materials

For further information on termites, see the following Extension publications:

- E-368, “Subterranean Termites”
- E-366, “Drywood Termites”
- E-369 “How to Select a Termite Control Service”

Also visit the following website: [urbanentomology.tamu.edu](http://urbanentomology.tamu.edu)

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