Pest Management Practices for Home and Landscape:

Subterranean Termite Control

Mississippi State University Extension Service

Termites are members of the insect order Isoptera, a relatively small group compared to some insect orders. For example, there are approximately 250,000 beetle (Coleoptera) species worldwide, while there are only about 1,900 termite species. Termites feed on wood and other cellulose materials they encounter in nature. Termites and other insects, along with wood-decay fungi, help recycle thousands of pounds of fallen trees, limbs, and grass stems, as well as some of the litter deposited on the landscape. This is a very positive benefit derived from termites; however, these insects also feed on lumber used in homes and other buildings. As a result of this feeding, millions of dollars are spent each year repairing termite damage and applying remedial or preventive treatments in and around structures.

Two broad categories of termites in Mississippi are subterranean and drywood. Subterranean termites, as the name implies, live within the soil and must maintain contact with the soil unless they have very moist aboveground conditions. Drywood termites live in aboveground wood sources (with no soil contact), and if they are found within structures, they are often around windows, at wood joints, at floor joists, or in doorframes. Structural drywood infestations can result from moving in furniture that was previously stored in a termite-infested storage space. Drywoods are typically found only in the coastal area of the state, while subterraneans are found statewide.

Subterranean Termite Types

Two groups, or genera, of subterranean termites in Mississippi are *Reticulitermes* and *Coptotermes*. The genus *Reticulitermes* includes three species: the eastern subterranean termite (*Reticulitermes flavipes*), or EST (Figure 1), the dark southeastern subterranean termite (*Reticulitermes virginicus*), and the light southeastern subterranean termite (*Reticulitermes hageni*). All three species are native to Mississippi and can be found statewide; however, the EST is the predominant species in the state and accounts for most damage associated with the group.

Figure 1

Termites in the genus *Coptotermes* are not native to the United States. Only one species, the Formosan subterranean termite (*Coptotermes formosanus*), or FST, is found in areas of the U.S., including Mississippi. This termite is native to the Far East and has moved from area to area via the commercial movement of goods and services. The first documented case in Mississippi was in the Meridian area in 1984 when Formosan subterranean termites were found, not in a house, but in some crossties at the front of a home. In fact, the use of crossties as landscape timbers has played a major role in the movement of this termite in the Southeast. The FST is found primarily in the coastal counties (infestations even in these counties are spotty) with scattered infestations at other sites in Mississippi.

Description and Habits

Termites live in colonies composed of many individual insects. There are different groups, or castes, within the colony, and each group carries out different tasks that are important for colony survival. Caste members present in the colony are:

- Nonwinged reproductive males and females
- Soldiers
- Workers
- Winged reproductive virgin males and females (also called swarmers or alates)

Nonwinged reproductive males and females are present in the colony in low numbers. This group includes the king and queen of the colony. At certain times, supplementary nonwinged reproductives may be produced, and this adds greatly to egg production within the colony. Homeowners rarely see these caste members.

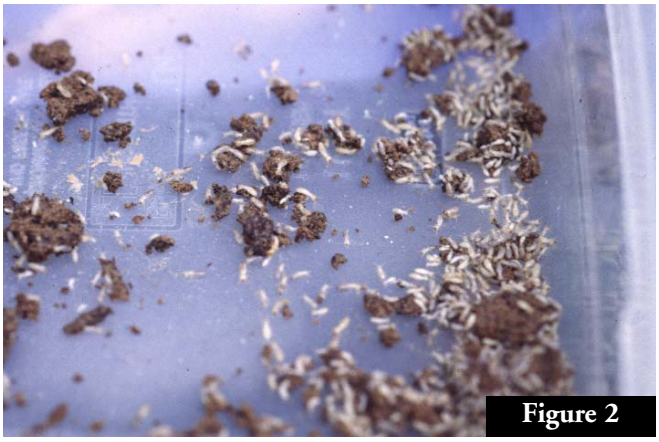


Figure 2

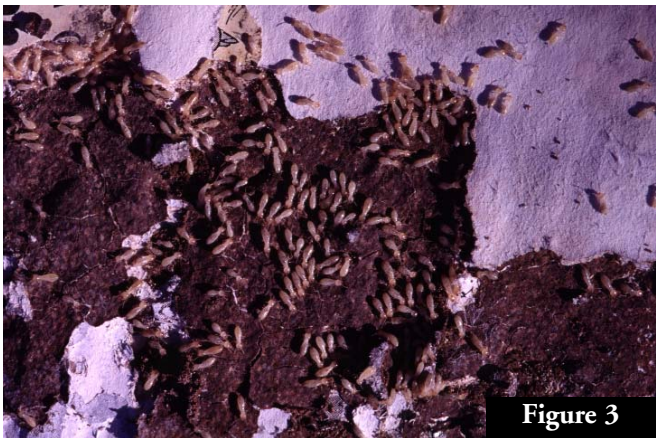


Figure 3

Figure 4

Soldiers, as the name implies, guard the colony from predatory insects, such as ants. Soldiers have a distinctive enlarged head and mandibles compared to other castes.

The caste name "worker" (Figure 2) is also descriptive. Workers care for reproductives and soldiers, tend eggs and immature termites, clean the colony area, gather food (structural damage is a result of worker feeding), build and repair shelter tubes, and enlarge the colony area, among other tasks. Workers are white in color, and thousands of them are usually present in a colony. Homeowners occasionally encounter worker termites while repairing windowsills or at other points around the home. Unfortunately, such an encounter indicates that the building has an active termite infestation (Figures 3 and 4).

Winged reproductive virgin males and females emerge from the colony in the spring, and hundreds or thousands may suddenly appear. They are often referred to as "swarmers," or "alates." After flying short distances, they land, lose their wings, and mate. A mated pair seeks out a protected site and, if successful at mating, forms a new colony. Birds, frogs, lizards, and other insects feed heavily on swarmers during this period. If a homeowner sees a swarming take place in his home, the unpleasant sight can be a traumatic experience. A person may observe the event while it is occurring or arrive after the event to find the insects on windowsills, in sinks or tubs, or crawling on the floor. Depending on the species, the swarmers may be black or tannish-yellow.

It is important to differentiate between the EST and the FST, and a number of factors can help make this determination. The time of year and time of day during which the swarm occurs, the shape of the soldier termite's head, the presence or absence of wing hairs, and the color of the swarmer are all important points to con-

Table 1: Comparison of eastern subterranean and Formosan subterranean termite spring swarmers, (winged reproductive virgin males and females, also called alates), and soldiers.

	Eastern Subterranean Termite	*Formosan Subterranean Termite*
Color of Swarmer or Alate	Black * (Figure 1)	Honey or Tannish-yellow
Time of Year of Swarming	Late February to Mid-May	Late May to June
Time of Day of Swarming	Morning	Late Evening to Night
Attracted to Light	No	Yes
Wing Hairs	No (Figure 5A)	Yes (Figure 8)
Shape of Soldier Head	Rectangular (Figure 6)	Teardrop (Figure 7)

* Winged forms of both the eastern subterranean termite and dark southeastern subterranean termite are black. However, the winged form of the light southeastern subterranean termite is yellow and might be confused with the Formosan subterranean termite. The light southeastern subterranean termite tends to swarm in late summer to early fall. In coastal counties, drywood swarmers are similar in color to the FST, but they do not have hairs on their wings.

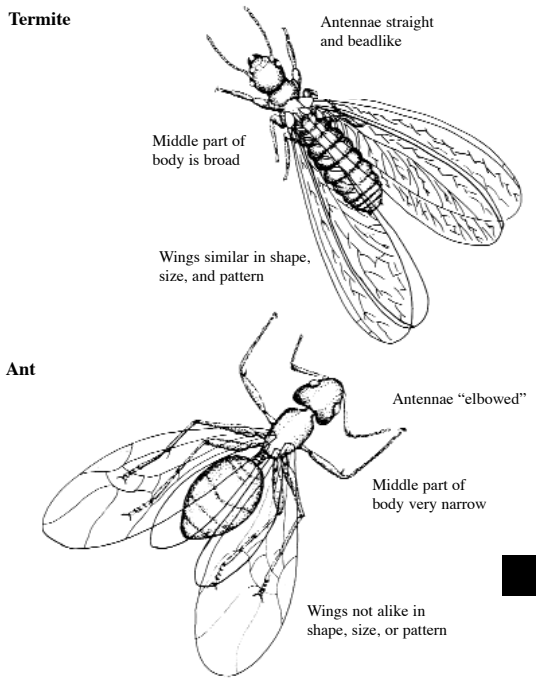


Figure 5

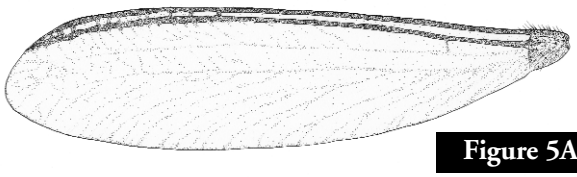


Figure 5A

Figure 6 Reticulitermes sp. wing. Scale bar = 5 mm

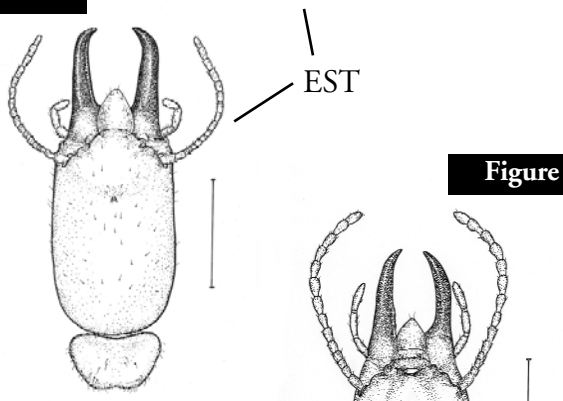
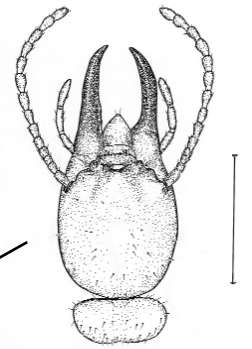


Figure 7



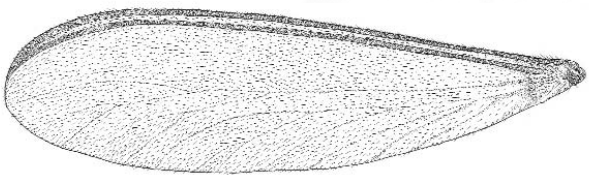


Figure 8

Coptotermes formosanus wing. Scale bar = 5 mm.

sider in identification. These characteristics are summarized in Table 1. Ants are also social insects and exist in colonies that will swarm. Although winged ants look similar to winged termites there are some major differences between the two forms. See figure 5 for the differences between winged ants and termites.

Subterranean termites are sensitive to drying conditions, such as wind and direct sunlight. The subterranean habitat provides protection from these environmental factors; however, termites also use other methods to protect themselves from the environment. One of these methods is building shelter tubes or mud tubes to or in aboveground food sources. These tubes are made from soil and secretions produced by the workers. Shelter tubes may be obvious on the sides of trees or the foundation, or hanging from floor joists in conventional foundations. However, some tubes may be constructed in foundation wall voids, like those in concrete blocks. Or if brick or other construction materials go below the soil, termites can build line tubes behind these materials. Likewise, termites may build shelter tubes through cracks in slabs or foundation walls, or through points where plumbing or electrical utilities enter the building. Homeowners and building managers should be familiar with shelter tubes and be able to recognize them if they appear around a home or other building.

Both the EST and the FST construct shelter tubes, but the FST will also build a soil-like material called carton within wall voids of infested structures. This material holds moisture and enables worker termites to spend more time feeding and collecting food resources before returning to the colony area. Carton can also complicate control measures. This is another reason for correctly identifying the termite species collected from an infested structure.

> *The FST may be able to establish an aboveground colony if there is sufficient moisture available in walls or roofs. Flat roofs can be vulnerable to leaks, and FST colonies may be more than one story above the ground.*

Control

Termites are present on most properties in Mississippi, and some houses may eventually develop a termite problem. But the mere presence of termites on your property or on your neighbor's property does not mean that your house will have a problem. There are a

number of termite control and prevention practices that can be used to protect structures in Mississippi. Some of these include a good foundation, liquid barrier treatments, in-ground monitoring stations, physical barriers (sheet-metal termite shields and stainless-steel mesh), insecticide-impregnated plastic sheeting, and, last but not least, good owner management practices for termite prevention. A discussion of each of these options follows. An option that may become available in the future is wood that has been dipped in a borate solution (disodium octaborate tetrahydrate). The process is called dipped diffusion and the borate penetrates the wood over time. It offers protection from termites (all types), beetles, and wood decay.

Foundations

The type of foundation used is important from the standpoint of potential termite entry points and how liquid treatments are applied pre- and postconstruction. Three general types of foundations are often used in construction throughout Mississippi: conventional (crawl space), monolithic slab, and supported slab.

- Conventional or Crawl Space (Figure 9): The floor of this foundation is elevated above the soil and rests on a foundation wall and piers. There should be at least 24 inches between the soil and the floor joists. This kind of foundation provides room to move about under the structure while checking inside foundation walls, piers, and floor joists in termite inspections, as well as providing room to apply remedial treatments if needed.
- Monolithic Slab (Figure 10): The cement for this foundation type is made in one continuous pour. This foundation offers fewer points of entry for termites, as long as the slab does not have major cracks. The weak points, also referred to as critical areas, are the bath trap areas located under tubs and showers, and the points where pipes or other service lines pass through the slab. Some contractors may also leave wooden grade stakes in the slab, greatly increasing the probability of postconstruction termite infestations.
- Supported Slab, L-Block Supported Slab (Figure 11): This foundation type is constructed in a two- to three-step process. It consists of footing, foundation wall, and slab. The footing is established 12 to 18 inches below the soil line and the foundation wall is erected on the footing. The foundation wall is usually constructed from concrete blocks and may be three to four blocks high. The top block is notched in the shape of a modified "L" measuring 4 inches by 4 inches. The pouring of the slab is the last step in the process and the outside edges of the slab will fit into the notched block at the top of the foundation wall. This is a very good foundation type; however, the weak point is the expansion joint between the foundation wall and the slab. Either the base plate or the flooring of choice usually covers this joint.

Potential problems common to any foundation type occur when construction materials, such as insulation, brick veneer, or stucco, extend below the soil line, cov-

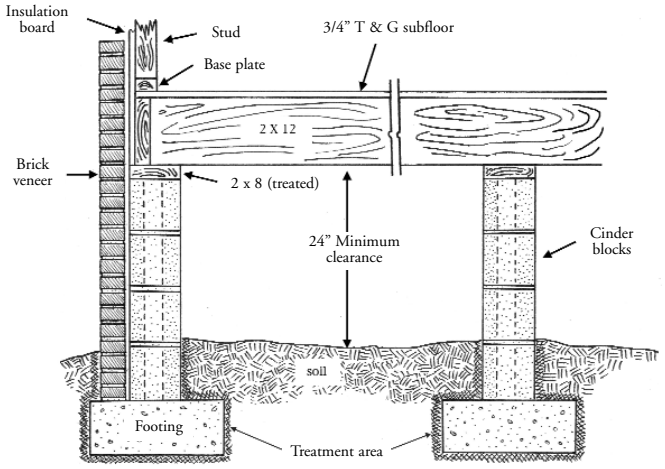


Figure 9

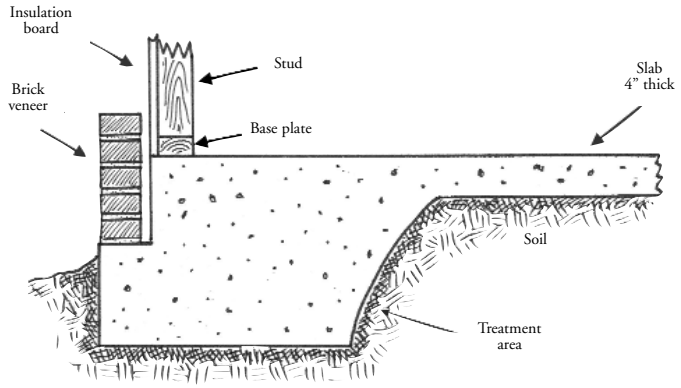


Figure 10

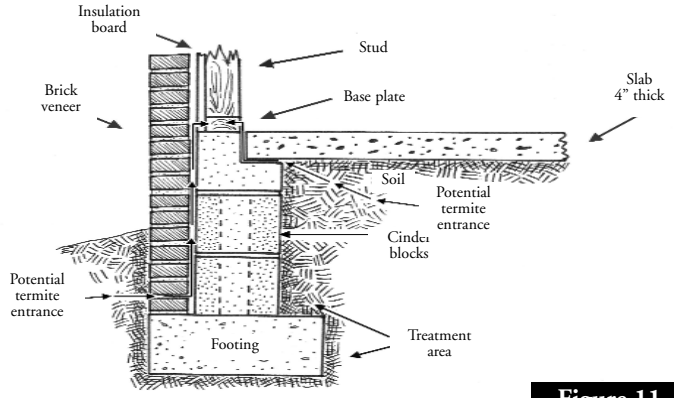


Figure 11

ering the outer foundation wall. This provides a potential hidden point of entry for termites. The worker termites could build shelter tubes through small spaces in mortar joints formed during settling, or work their way up from the footing, get behind stucco or insulation board, and eventually enter the walls. Insulation or stucco may also draw moisture into wall voids during wet periods, creating conditions conducive to termites and/or wood decay. If any of the above materials extend below the soil line, contractors or architects should work closely with a professional pest control service to ensure that the pretreatment volume or treatment technique is sufficient to carry the insecticide solution below the brick ledge or below the bottom of the insulation or stucco. This will help prevent termite invasions, although it will not prevent the wicking action that may occur when stucco or insulation is below the soil line.

Liquid Barrier Treatments

Historically, termite protection has been accomplished by the placement of an insecticide barrier between the wood components of the house and foraging termites. This method is generally referred to as a liquid treatment and may be used as a preconstruction or postconstruction treatment. **It is still a valid option for treatment.** An application of this type involves the use of a liquid concentrate diluted with water and applied around or under foundations. A number of products can be used in this method, and most labels will give a range of concentrations that can be used. However, most bids usually are based on the lowest percentage allowed by the label. Diluted concentrations range from 0.06 percent to 0.5 percent depending on the product used. Two important barriers are the horizontal barrier under the slab and the vertical barrier along the inside and outside foundation wall. Square footage (under the foundation) or linear feet (around the structure) will dictate the amount of dilution applied. Several active ingredients–fipronil, imidacloprid, chlorfenapyr, bifenthrin, cypermethrin, permethrin, and fenvalerate–can be used, but most are available only through professional pest control services. The first three listed active ingredients are nonrepellent materials, and the remaining products are repellents. Liquid treatments may be applied preconstruction, or any time termites are discovered within the structure after construction.

- Preconstruction Treatment, or "Pretreat." A pretreat is actually applied in two different applications. The first application is applied to the soil surface (horizontal barrier) prior to laying the foundation. This is by far the easiest time to apply

Table 2: Treatment volumes used to establish pretreatment horizontal and vertical barriers for three common foundations used in residential construction in Mississippi.

Foundation Type	Pretreatment Barrier Volumes	
	Horizontal	Vertical
Monolithic Slab	Treat under the slab with 1 gallon of dilution per 10 square feet.* Apply 3 to 5 gallons at and around each critical point, or according to label directions.	After construction and cleanup, trench and treat the perimeter with 4 gallons of dilution per 10 linear feet, per foot of depth of the footing.**
L-Block Supported Slab	Treat under the slab with 1 gallon per 10 square feet. Apply 3 to 5 gallons of dilution at and around each critical point or according to label directions.	Before pouring the slab, trench and treat the inner perimeter of the foundation wall with 4 gallons per 10 linear feet, per foot of depth of the footing.** Trench and treat the perimeter of the outside foundation wall after construction and cleanup are complete. Use the volume indicated above.
Conventional Foundation	Treat under foundation wall and pier footings before pouring the footings at 1 gallon per 10 square feet.	Before the sub floor is put in place, trench and treat the inner foundation wall perimeter and around the perimeter of piers with 4 gallons per 10 linear feet, per foot of depth.** Trench and treat the perimeter of the outside foundation wall after construction and cleanup are complete. Use the volume indicated above.

*If the fill is gravel, horizontal barrier volume will be 1.5 gallons per 10 square feet. Also, labels make allowances for unusual soil conditions.
**If the footing is 2 feet deep, the volume will be 8 gallons per 10 linear feet, and so on, up to a depth of 4 feet. As depth increases, rodding should be included with the trenching process.

a preventive termite treatment. The second part of the pretreat is applied to the perimeter of the building (vertical barrier) after final cleanup and after ornamental plantings are installed. After digging a trench around the edge of the foundation, the diluted solution is applied to the trench. Consult Table 2 for treatment volumes.

- Postconstruction Treatment. This treatment is applied any time termites are discovered in the building after construction. Depending on the type of foundation, applications made postconstruction can be very difficult to apply. Treatments made at this time often include trenching the soil around the building, drilling the lower brick veneer, drilling voids in foundation walls, drilling through slabs, treating bath traps, etc. In some situations, foam may be used rather than a water-based dilution. Foams work well in dirt-filled porches, fireplace bases, or other hard-to-reach voids. Insecticides applied as foam are a mixture of insecticide, air, and foaming agent. The consistency of the foam is an important factor in its effectiveness. If the consistency is too thick or too thin, the material will not flow into voids properly, defeating the purpose of using the foam.

In-Ground Monitoring Stations

This termite control system is relatively new, and a number of active ingredients are available for use with it, including diflubenzuron, hexaflumuron (which will eventually be replaced with noviflumeron), and hydramethylnon. Systems vary depending on manufacturer, but there are some common points shared among them. In-ground stations are placed around the outside perimeter of the structure at approximately 10-foot intervals and should be checked with some degree of frequency. Specifications will vary based on manufacturer, so the buyer should understand the frequency at which the stations need to be checked. Based on research done at the University of Florida, monthly checks are preferable over longer time intervals.

> *While developing the in-ground concept, researchers checked the stations monthly; however, some labels may now call for checks every quarter or at some other time interval.*

The active ingredient may be added when the station is placed in the ground, or the station may start only as a monitoring station containing wood. In the latter case, the active ingredient is placed in the station after termites are discovered feeding on the wood. Some manufacturers also have stations that can be used at the feeding source within the structure if the feeding site can be identified.

Two of the in-ground monitoring ingredients mentioned above, diflubenzuron and hexaflumuron, are insect growth regulators that work slowly. Research shows that it may take several months to a year for termites to gather enough of the active ingredient to achieve the desired effect. The other product, hydramethylnon, is a delayed-action toxicant which eventually kills the termites, but this process is also slow. Buyers of these systems need to understand this concept, especially if they have active termites within their structure.

If an in-ground monitoring/control station is the primary system available for termite protection, this system must be maintained for the life of the structure to provide effective termite protection. If the stations are removed, termite protection is removed at the same time.

Physical Barriers

Termite shields are still used to some extent in conventional foundation construction. In this method metal caps are placed on top of piers and foundation walls. The metal extends out 3 to 4 inches on either side of the top, and the excess turns down at a 45° angle. This would appear to be an effective control procedure. However, termites will tunnel out over the shields, so this is not a good stand-alone control option. Despite this, the shields do have the positive benefit of functioning as an excellent survey tool. The presence of the shields will force those termites that may tunnel up the inside of piers or foundation walls to the outside before they can enter the floor joists, as long as the shields do not have holes or unsealed joints.

A finely woven stainless-steel mesh (0.66 mm by 0.45 mm) is a physical barrier that provides termite control, as long as it is not breached. Advise your contractor against driving grade stakes through the mesh. Termites cannot chew through this material, nor can they move through the small openings. Studies in Australia show the product to be very durable. It is much easier to apply this material before the foundation is in place, although it has been used quite extensively as a postconstruction treatment in Hawaii. Currently this product is not widely available in the U.S. Cost may be a factor, but if it is applied correctly under slab foundations, it should last for the life of the house.

Insecticide-Impregnated Polymer

This method is intended only as a preconstruction treatment for slab foundations. It consists of rolls of 16-mil polymer sheet with an intermediate (lambda-cyhalothrin) insecticide-impregnated sheet. It also serves as the vapor barrier for the slab. Sheets of polymer are rolled out over the prepared foundation. One sheet should overlap the adjacent sheet by 4 inches. As the sheets are put into place, the seams are heat-sealed. Care must be taken to seal the blanket around utilities such as electrical conduits or plumbing lines that will penetrate the slab. Sealing must be done according to label directions. Experienced installers for this system are not widely available, so potential users need to understand this and be very insistent on proper installation.

Termite control systems such as stainless steel and poly sheeting offer protection when placed under foundation walls, piers, or slabs (poly is recommend only for slab construction); however, they do not protect the perimeter. An additional treatment will be needed along the outside foundation wall.

> *Do not allow grade stakes to penetrate any termite control system, insecticide barrier, mesh, or the insecticide-impregnated poly.*

Good Owner Management Practices

With some planning, a homeowner can take steps to prevent or decrease the possibility of termite infestation. The following are several preventive measures:

- Do not alter the grade around a building in such a way that could cause water accumulation against the foundation.
- Do not stack material such as firewood next to the foundation.
- Do not buy used crossties for use in landscaping.
- Do not stack mulch over the treated zone adjacent to the foundation.
- Do not till the area immediately adjacent to the foundation when planting ornamentals.
- Do not plant ornamentals so close to the foundation that one cannot inspect the outer perimeter of the home, or so close that they reduce air flow around the structure. Plan on a zone of 18 to 20 inches between the mature width of the selected ornamental and the wall of the structure.
- Do not block crawl space ventilation vents if the structure is built on a conventional foundation.
- When planning new construction, do not allow building materials (stucco, insulation, or brick ledges) to extend below the soil line. This invites termites and moisture problems.
- Do not make additions to the existing structure without having the soil treated prior to pouring the new foundation.
- Do not make additions to the existing structure that will cause wood-to-soil contact.
- Do inspect the outside perimeter once a year looking for signs of termites, termite tubes, or decay. Inspect the lower portion of the foundation for tubes, and test wood around windows, doors, and other exposed wood for signs of decay or feeding tunnels.

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