DRYWOOD TERMITES

Integrated Pest Management in the Home

The western drywood termite, *Incisitermes minor* (Fig. 1), is California's second most important termite pest after the western subterranean termite. It is a native insect that has been here millions of years, mostly attacking trees along river washes and arroyos. In California drywood termites are most prevalent in southern California and the Central Valley but also can be found infesting wood along the coast, in bay areas south of San Francisco, and in the southern California desert. For more information on the biology and distinguishing characteristics of this and other termite species common in California, see *Pest Notes: Termites*, listed in References.

Because of the difficulty in detecting drywood termites and determining the extent of the damage done, do-it-yourself treatments are not recommended; consult a pest control professional. Over-the-counter products with drywood termites on the label for do-it-yourself enthusiasts do not exist. Except for wood removal, homeowners should seek help from pest control professionals. This publication is intended to provide homeowners with sufficient background information so that they can better discuss treatment options with pest control professionals; it is not intended as a treatment guide.

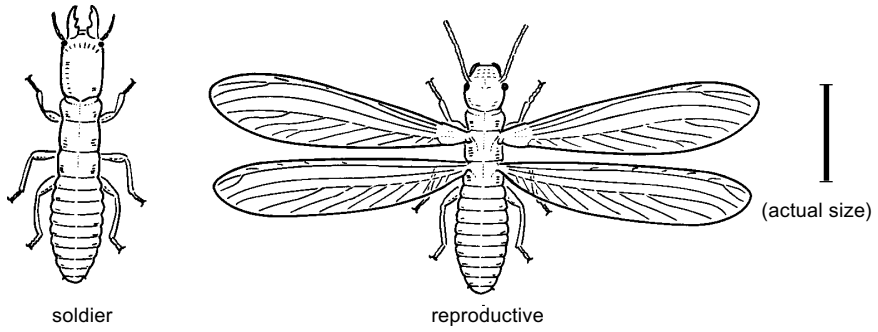

Figure 1. Western drywood termite.

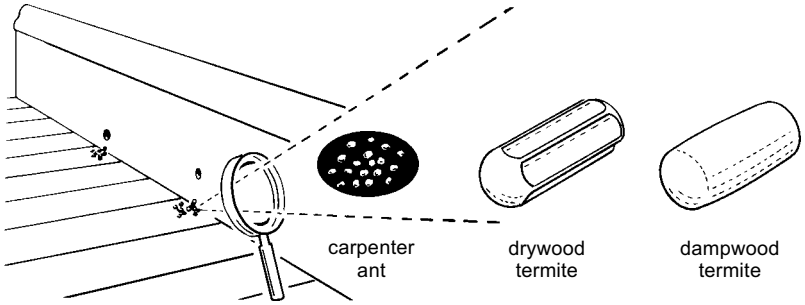

Figure 2. The fecal pellets produced by drywood termites are elongate with rounded ends and have six flattened or roundly depressed surfaces separated by six longitudinal ridges.

DETECTION

Drywood termites are secretive insects and are difficult to detect. They live deep inside wood and, except during periods when they swarm or when repair work is being done on infested homes, they are seldom seen. Colonies are small (usually fewer than 1,000 individuals), can be widely dispersed, and take years to mature. While a homeowner may initially detect the presence of termites when they swarm or if fecal pellets are discovered, inspecting for drywood termites and determining the extent of an infestation require experience.

The minimum requirement by California state law for drywood termite inspections includes visual searches of accessible areas. However, detection of difficult-to-find infestations may require removal of walls, paneling, and stucco as well as the use of ladders and scaffolds.

During a visual inspection for drywood termites, inspectors look for feeding damage, shed wings, termite fecal pellets, and kickout holes (Fig. 2), which are small holes the size of BB shot through which termites push fecal pellets out of the wood. Fecal pellets, hexagonal in shape, are diagnostic for drywood termites. However, whether the infestation is currently active or what the extent of the infestation is

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cannot be determined from pellets alone. Cleaning up the fecal pellets around a kickout hole and checking a few days later to see if new pellets have appeared can help to determine if an infestation is active. (Building vibrations/movements may cause some pellets to appear.) If an active infestation of drywood termites is found in your structure, you should have it treated.

Other detection methods include the use of dogs, odor detectors, and feeding-sensitive (acoustic emission) devices, but these are infrequently used. Fiber optics, borescopes, and movement-sensitive devices using microwaves have also been tried, but their reliability has not yet been scientifically tested on drywood termites. Except for feeding-sensitive devices, most detection methods are still considered experimental because adequate research has not been conducted on their effectiveness. Visual searches by inspectors for evidence of termites and damage remain the mainstay of the industry.

ELIMINATING EXISTING INFESTATIONS

All drywood termite control methods can be categorized as either whole-structure or localized. A whole-structure treatment is defined as the simultaneous treatment of all infestations, accessible and inaccessible, in a structure. A localized or spot treatment is more restrictive, often applied to a single board or small group of boards. Homeowners are advised to know the distinction between whole-structure and spot treatments when deciding which method to select because all treatment methods are not equivalent.

Whole-structure treatments have an advantage over spot treatments in that they can eliminate all infestations, even hidden ones. With the uncertainty of current detection methods, particularly when drywall or other wall coverings conceal infestations, there is always some doubt as to the extent of drywood termite colony boundaries within homes. Consequently one can never be sure that all infestations have been treated when applying spot treatments. The strengths and limitations of whole-structure and spot/localized treatments are outlined in Table 1.

Whole-structure Treatment

Fumigants (sulfuryl fluoride) treat all infestations simultaneously and have high levels of efficacy if correctly applied. Sulfuryl fluoride kills drywood termites in about 3 days. A monitored fumigation, which involves installing gas monitoring lines inside the structure undergoing treatment, has the highest rate of treatment success. Non-monitored fumigation may not have enough gas concentration to kill infestations, and failures may occur. Fumigation's advantage over localized treatment is that it may eliminate infestations that are hidden from view. Major issues to consider with the use of fumigants include the difficulty of installing tarpaulins, the difficulty in determining the proper dosage, the need to protectively bag food items, and the lack of residual control. Residual control means long-term protection (several years or more) from drywood termite attack. (Generally, only chemicals added to or onto wood provide residual control.) It will also be necessary to vacate the structure for 2 to 3 days while it is being treated and then ventilated. Additionally, roofs may be damaged by having tarpaulins dragged across them.

Methyl bromide was another fumigant used for many decades in California to control drywood termites. However, because of environmental concerns about the atmospheric ozone layer, the strong odors of some formulations, the long aeration times for fumigated structures, and the need for extensive aeration buffer areas around structures, this fumigant has been phased out for urban use in California.

Heat is a nonchemical option for whole-structure treatments. Excessive heat kills drywood termites by disrupting cellular membranes and denaturing enzymes needed for their survival. The treatment process involves heating all wood in the structure to a minimum of 120°F and holding this temperature for at least 33 minutes. The benefit of heat treatment is the ability to treat the entire structure without the use of chemicals and the relatively short period of time the structure must be vacated (hours instead of days, as with the use of fumigants). An additional advantage is that portions of large structures can be treated separately, which is very useful in apartments and condominiums. The major drawbacks of heat treatments include the difficulty in raising the internal core temperature of large structural beams that are infested and heat sinks, which are areas within the structure that are difficult to heat, such as wood on concrete or tile. As more powerful and efficient heaters are developed, larger homes can be efficiently treated with heat.

Other issues to consider include damage to heat-sensitive items in homes including plastics (e.g. electrical outlet covers) and cable wiring. Also, like fumigants, heat treatments have no residual control. Of course, preventive chemicals can be applied to areas treated with fumigants or heat for long-term protection (see preventive section in Table 1).

Localized or Spot Treatments

There are many localized/spot treatment methods available (Table 1) that include both chemical and non-chemical options. The **chemical options** include aerosol pyrethrum and aerosol and liquid pyrethroids (cyfluthrin, permethrin, bifenthrin), liquid imidacloprid, liquid nitrogen, and liquid and dust formulations of disodium octaborate tetrahydrate. Chemicals that have been phased out of commercial use include organophosphates, carbamates, silica-gel, and dridie. For liquid and dust insecticides to be effective, termites must touch or ingest them. Spot treatments should be applied only by licensed applicators. Home use products are not effective.

Depending on the chemical used for spot treatments, laboratory studies have shown a variation of 13% to 100%

TABLE 1. Summary of Commercially Available Drywood Termite Management Options.

Treatment	Efficacy in field	Strengths	Considerations/Limitations	Damage to structure
EXISTING INFESTATIONS				
Whole-structure				
Fumigants	up to 100% [1, 2, 3]	hidden sites treated	correct dosage must be achieved; residents must leave house; no residual	gas pilots must be extinguished before treatment; possible damage to roof from tarpaulins or if walked on
Heat	up to 100% [2]	hidden sites treated	lethal temperature must be achieved in the core of all infested wood; no residual; heat sinks may affect efficacy	possible damage to roof if walked on and for some heat-sensitive household items
Localized/Spot treatments				
Chemical				
Chemical liquids & dusts	up to 90% [3]	long-term	few active ingredients commercially available; detection accuracy critical; chemical residual; results vary with active ingredient used and concentration; infestation may rebound	yes, if drill holes used
Chemical foams	no information	coverage of hidden infestation, long-term	no published efficacy studies	yes, drilling holes
Liquid nitrogen	74 to 100% [2]	benign material	highly dependent on dosage; detection accuracy critical; no residual	yes, drill holes
Nonchemical				
Biological control	no information	no chemicals	few commercially available; research needed	don't know
Electrocution	44 to 98% [2]	portable	detection accuracy critical; many disclaimers; infestation may rebound	yes, if drill holes used
Heat	up to 100% [2]	semi-portable	lethal temperature must be achieved in the core of all infested wood; no residual; heat sinks may affect efficacy	may be to wood or heat-sensitive household items
Microwaves	89 to 98% [2]	semi-portable	detection accuracy critical; highly dependent on treatment time and wattage; heat sinks may affect efficacy	may be to wood or household items
PREVENTIVE				
Chemical liquids & dusts	up to 90% [3]	long-term	few active ingredients available; chemical residual; results vary depending on active ingredient used and concentration; infestation may rebound	yes, if drill holes used
Pressure-treated wood	no information	long-term	few active ingredients commercially available; chemical residual; results vary with active ingredient used and concentration; environmental persistence	no
Nonchemical				
Barriers (screens/paint)	no information	long-term	barriers degrade & can be breached; some feeding damage may occur	no
Resistant woods	no information	long-term	efficacy highly variable depending on species of wood; costly; availability; some feeding damage may occur	no

1 - Su & Scheffrahn 1986; 2 - Lewis & Haverty 1996; 3 - Scheffrahn et al. 1997

in their effectiveness in controlling drywood termites. However, many of these chemicals have not been tested in large-scale field-tests. A newer insecticide (imidacloprid) with very good lab and field results is available and will be used increasingly in California. Botanical-based products (orange oil and neem oil) have been tried, but there are no published studies that verify the efficacy of these materials in controlling drywood termites. Recent experiments evaluating surface or gallery injections of aqueous disodium octaborate tetrahydrate did not effectively control a closely related species of drywood termites, *Incisitermes synderi* (Scheffrahn et al. 1997).

Liquid nitrogen is different from other spot treatment methods in that its mode of action is thermal; it causes a sudden drop in temperature, which kills the termites. Laboratory studies have shown drywood termites are killed after momentary exposures of temperatures in the range of -5.8°F to 1.4°F when temperatures were lowered from room temperature at a rate of 33.8°F per minute (Rust et al. 1997). Studies on liquid nitrogen show that dosages exceeding 30 pounds per enclosed wall space between 2 by 4s achieve high levels of effectiveness. Although most chemicals used for spot treatments give long-term control, liquid nitrogen has no residual activity when used alone. Minor damage to the structure occurs from the holes drilled for spot treatments of chemicals and for liquid nitrogen insertion. For all chemical spot treatments, including liquid nitrogen, it is critical that all infestations in a structure are detected so that they all receive treatment.

There are four **nonchemical options** for drywood termite control with spot or localized application (Table 1), including *heat*, which is used for both spot and whole-structure treatments. The advantages and disadvantages discussed for heat as a whole-structure treatment also apply to spot treatments. *Microwave* devices are also available for drywood termite control. Microwaves kill termites by causing fluids inside their cells to boil, which destroys cell membranes; in short, the termites are cooked inside the wood. There are a number of firms now offering microwave treatments. One advantage of microwaves is their relative portability; another advantage is that they leave no chemical residue. When using microwaves, however, detection accuracy is critical to success. Both microwaves and heat treatments may damage the surface or interior of wood boards, depending on the power of the device. (The wattage or power of microwave or heating devices may vary from several hundred to more than 10,000 watts.) Lab studies revealed no relationship between increasing microwave wattage and drywood termite mortality (Lewis et al. 2000). As with heat treatments, it may be difficult to heat areas with heat sinks to high enough temperatures with microwaves for effective control.

High voltage electricity, or *electrocution*, is another nonchemical option for controlling drywood termites. The device currently marketed uses high voltage (90,000 volts) but low current (less than 0.5 amps). Death to drywood termites occurs by electric shock, although delayed mortality may also occur from the destruction of intestinal protozoa. The advantage of electrocution is that the equipment is portable. The limitations include detection accuracy and the possible reduced efficacy from the interfering actions of common building materials, for example metal, concrete, and glass. If drill holes are used to enhance the flow of current into wood, damage occurs to wall coverings, walls, and structural wood members.

Wood replacement is another remedial treatment option. However, similar to other spot treatments, its effectiveness is highly dependent on detection accuracy and extent and location of the infestation, and it may be expensive to accomplish.

There is little research on biological control of drywood termites. Biological control is the use of other life forms (e.g., insects, nematodes, or microbes) to control pest insects. Although predators, parasites, and pathogens have been shown to control other insect pests, their efficacy for drywood termite control has not been explored.

LONG-TERM PREVENTIVE TREATMENTS

Although chemicals are commercially available in California for long-lasting prevention against infestation, there is little data on their effectiveness against the drywood termites that occur in California. Recent research from the University of Florida demonstrates that new colony establishment by another species of drywood termite, *Cryptotermes brevis*, could be prevented using dust formulations of commercially available disodium octaborate tetrahydrate (Scheffrahn et al. 2001). Drawbacks with some chemical preventive treatments include damage from drill holes and unsightly appearance from dusts.

Pressure-treated wood (chemically treated wood that is green in color) for drywood termite prevention can be effective for species that occur in California. However, the use of most wood preservatives has been restricted. Painting of wood with enamel, shellac, or varnish gives very little protection against drywood termite feeding.

Integrating nonchemical and chemical treatments to ensure that termites are not able to colonize over the long term is a strategy used by some pest control professionals. Nonchemical, long-term preventive methods include physical barriers, such as metal screens. Resistant woods can reduce but do not eliminate damage. There are few studies that demonstrate the efficacy of combinations of methods or of nonchemical, long-term preventive treatments directed against drywood termites.

DID I MAKE THE RIGHT CHOICE?

When planning treatment for drywood termites, consider whether the whole structure is to be treated or just localized areas. Localized/spot treatment methods make it more difficult to ensure complete control because of the

difficulty in determining the extent of a drywood termite infestation. There also appears to be considerable variation in effectiveness of various techniques from applicator to applicator. Read your guarantee carefully; you may wish to consider an annual inspection service. Also important is a company's reputation. There are thousands of pest control companies in the state. They don't all have the same services or performance. Obtain at least three vendor bids before you decide. Check the reliability of the vendor by asking for client referrals and check the status of its business license and consumer complaints with the California Department of Consumer Affairs, Structural Pest Control Board, in Sacramento and with your local Better Business Bureau. For added information on safety of chemicals to humans and structures, request the Material Safety Data Sheets or equivalent information for nonchemical control methods from the pest control company.

In summary, research indicates that if you correctly locate the colony and get the chemical or nonchemical treatment directly onto the termites, the effectiveness of control will be high (90%). For failed treatments, an additional callback treatment may lead to better results.

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