Drywood Termite Control

Preliminary laboratory evaluation of chemical local treatments for drywood termites

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Local chemical treatments for the western drywood termite, *Incisitermes minor* (Hagen), control in California have been conducted by pest management professionals (PMPs) for decades. Some estimates claim as much as 70 percent of the treatments made by PMPs for drywood termite control use local treatments rather then whole-house heat or chemical fumigation. Dozens of products have been registered for termites. Some commonly used products today include Bora-Care® (disodium octaborate tetrahydrate (DOT) 40 percent, Nisus Corp., Rockford, TN), Optigard™ ZT (thiamethoxam 21.5 percent, Syngenta Crop Protection, Inc., Greensboro, NC), Premise Foam® (imidacloprid 0.01 oz/lb, Bayer Environmental Science, East Hawthorn, Vic.), Termidor SC (fipronil 9.1 percent, BASF Corp., Research Triangle Park, NC , Tim-Bor® (DOT 98 percent, U.S. Borax Inc., Valencia, CA), and XT-2000 (92 percent *d*-limenone, Formulated Solutions, Woodside, NY).

Some confusion in the industry and consumers exists over advertising claims of local treatments for drywood termites being equivalent to whole structure treatments using fumigation and heat. For most of the products above, there are gaps in our understanding or no published papers that pertain to California conditions and species of drywood termites. The PMPs' decision-making process is hampered without reliable efficacy information substantiating product performance claims. Additionally, consumers' confidence in the PMP may suffer.

The Structural Pest Control Board (SPCB) in 2006 and 2007 awarded contracts to the University of California to conduct evaluations on the effectiveness of six commonly used products for drywood termite control. The contracts called for Dr. Michael Rust, Department of Entomology, UC Riverside, to conduct the laboratory component and Dr. Vernard Lewis, Department of Environmental Science, Policy, & Management, UC Berkeley to direct the field component. Both investigations are currently ongoing, final completion date and reports are due in June 2009.

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Findings presented in this paper are preliminary laboratory results from both UC laboratories on product activity.

The following sections contain methods and results from a UC Riverside laboratory study using wood wafers that were topically applied with one of six products then presented to groups of drywood termites. Investigations from UC Berkeley used naturally infested structural boards containing active drywood termite infestation that were drilled and injected with the same six products.

UC Riverside study

The objective of this study was to determine the insecticidal activity and potential efficacy for several registered products against drywood termites. The products tested in the study included Bora-Care® (disodium octaborate tetrahydrate 40 percent), Optigard™ ZT (thiamethoxam 21.5 percent), Premise Foam® (imidacloprid 0.01 oz/lb), Termidor SC (fipronil 9.1 percent), Tim-Bor® (disodium octaborate tetrahydrate 98 percent), and XT-2000 (92 percent *d*-limenone). Each of the products was prepared according to label directions and applied at the recommended rates. Worker termites were collected from pieces of infested lumber and wood and were kept in a sealed plastic Tupperware containers (8" by 12" by 3.3"), provisioned with pieces of balsawood, and vials of water with cotton wicks were added occasionally to provide moisture. The termites were allowed to acclimate for about two weeks before testing.

Bora-Care was diluted with water 1:1 to a 20 percent solution of DOT. The Tim-Bor was mixed at 10 and 15 percent solutions. The XT-2000 was applied directly undiluted to the balsa surfaces. The Termidor was applied as an aqueous preparation at 0.12 and 0.06 percent. The aqueous preparations were applied with a pipette to the wood surfaces. Premise foam was applied directly from the aerosol can. The Optigard ZT was prepared according to the label directions at a 15:1 ratio and applied with the Optigard ZT Foamer Kit.

Disks of balsawood were treated with various liquids, dust or foam formulations. The balsawood (1/8" by 4" by 48"; Midwest Products Co., INC., Darien, IL) was cut into 3.5"-diam. disks, placed in the bottom of glass petri dishes, and treated. Balsawood was selected because thin sheets prevent termites from tunneling into the wood making them visible for counting and termites will readily feed on it. Bora-Care was applied at rate of 2 gal/ 1,000 ft² of treated wood. The 15 percent Tim-Bor solution was applied once and allowed to dry overnight. The 10 percent solution was applied and allowed to dry overnight before a second application was made. Both solutions were applied at a rate equivalent to 0.5 gal/ 1,000 ft². The Termidor and XT-2000 were applied at a rate equivalent to 1 gal/ 518 ft².

Disks (0.9" diam.) of balsawood were cut from the larger treated disk. The disk was placed treated-side up in the bottom of a small glass petri dish (0.9" diam. by 0.8"). For each treatment, six workers were placed on each of three treated surfaces (n=18). The vials and termites were placed in a chamber maintained at 75 percent RH in the dark. The number of dead termites on each disk was counted regularly and the dead were removed. Tests were conducted when the surfaces were one and 30 days old.

UC Berkeley study

The objectives for this laboratory investigation were to calibrate detection equipment, insecticide application equipment, and PCO application technique with the same six products tested in the UC Riverside study. Before going into the field, Dr. Lewis felt it would be necessary to conduct a practice round of laboratory tests with a collaborating PCO before initiating actually field trials under "real world" conditions.

Boards presumed to contain live termites were provided by cooperating PMPs. Level of termite activity was determined with portable detection equipment (Termite Tracker, Dunegan Engineering, Midland, TX; and X-ray device XR200, Golden Engineering, Centerville, IN). Boards were determined to contain active drywood termites by drilling a 1/8" dia hole and inserting the Tracker sensor probe roughly ¾" deep and taking three one-minute readings of termite feeding activity. This process was repeated every 18" down the length of the board. Three different board dimensional sizes (e.g., 2 by 4s and 2 by 6s, 2 by 8s and 4 by 4s, and 4 by 6s and 4 by 10s) were stratified within treatment groups. Prior to treatment, all chemically treated and water only boards were drilled 1/8" dia in a pattern that consisted of two diagonal holes spaced approximately 2" apart, down the length of the board for board dimensional sizes of 2 by 8 or less. For board dimensional sizes 4 by 4 and larger, two opposite sides of the board were drilled and treated.

A state licensed structural pest control applicator conducted all drilling of holes and product applications. Label instructions were followed and maximum product rates were used. The Bora-Care was diluted 1:1 with water to a 20 percent final solution DOT and was injected into drilled holes as a liquid using a one gallon durable plastic hand pressurized sprayer (NPD Products, Midhurst, Canada). The Optigard ZT was prepared according to the label directions at a 15:1 foam ratio and injected into drilled holes with the Optigard ZT Foamer Kit. The Premise foam came as ready-to-use in a pressurized aerosol can equipped with an applicator tip and was injected into drilled holes. The Termidor SC was injected into drilled holes as an aqueous preparation at 0.12 percent final solution using a 1 gallon stainless steel hand pressurized sprayer (B&G Equipment, Jackson, GA). The Tim-bor was mixed in water at a final 15 percent DOT solution and injected into drilled holes using a 1 gallon durable plastic hand pressurized sprayer (NPD Products, Midhurst, Canada). The XT-2000 was injected undiluted directly from the container into drilled holes using a one gallon stainless steel hand pressurized sprayer (B&G Equipment, Jackson, GA). All boards were randomized before treatment. In addition, two checks were included in the study: treatments with and without water. For the water checks, tap

Table 1. Mortality of western drywood termites, *Incisitermes minor*, in continuous exposure tests on fresh and 30-day-old deposits of treated balsa wood. Laboratory tests conducted at UC Riverside.

		% dead at day			
	Age				
Treatment	(days)	1	7	14	26
Timbor 15%	1	33.3	50.0	61.1	83.3
	30	27.8	100		
Timbor 10%	1	33.3	50.0	61.1	100
	30	0.0	0.0	16.7	55.6
Timbor dust	1	0.0	100		
	30	N.A.			
Bora-Care	1	11.1	50.0	88.9	88.9
	30	N.A.			
XT-2000	1	5.6	33.3	100	
	30	0.0	0.0	22.2	50.0
Termidor 0.125%	1	100			
	30	100			
Termidor 0.0625%	1	61.1	94.4	100	
	30	88.9	100		
Premise 0.5%	1	5.6	38.9	66.7	88.9
	30	0.0	5.6	5.6	77.8
Optigard Foam	1	100			
	30	100			
Untreated	1	5.6	16.7	16.7	22.2
	30	0.0	16.7	44.4	61.1

a Treated wood was allowed to dry for 24 hours before testing.
N.A. – data not yet available.

Table 2. Average number of drilled holes, average volume of product injected, and percentage dead at three months post-treatment for infested boards containing drywood termites drilled and injected with six products and untreated checks. Laboratory investigations conducted at UC Berkeley.

Treatment	Average number drilled holes per board	Average vol product injected (oz) per board	% Dead
Bora-Care®	53	18	98%
Optigard™ ZT	45	6	81%
Premise Foam®	43	5	41%
Termidor® SC	35	13	100%
Tim-bor®	29	10	99%
XT-2000	48	5	81%
Water only	29	13	6%
Untreated	0	0	3.3%

water was injected into drilled holes using 1 gallon stainless steel hand pressurized sprayer (B&G Equipment, Jackson, GA). Each treatment and the untreated checks were replicated three times. After treatment, boards were kept at the University of California Richmond Field Station in a laboratory at ambient conditions for three months. During the three months, post-treatment evaluations were made that included taking Tracker readings for termite feeding activity at seven days, one month, two months, and three months. At three months, all the boards were dissected and the number of dead and live termites counted.

Preliminary results

Both laboratory tests represent best-case scenarios, whereby the termites were directly exposed to treated surfaces and in a situation where we made a very thorough local treatment. For product deposits that were aged one day, mortality was at least 83 percent at one-month post-treatment (Table 1). For deposits that were aged for 30 days, Timbor 10 percent, XT-2000, and Premise 0.5 percent Foam, were not significantly different than the untreated control at the 30 day post-treatment evaluation period (Table 1). These data suggest that the active ingredient is not readily available to the termites and these products lose contact activity quickly soon after application. Post-treatment monitoring of termite feeding activity using the Tracker device was able to detect the failed Premise Foam treatments within the first week after treatment (Figure 1), reinforcing the usefulness of using detection equipment to demonstrate efficacy of treatment and as an aid for verifying possible treatment failures discovered during recall visits. The termite feeding activity monitoring data also suggest immediate mortality at seven days or less (Figure 1). The high levels of mortality from the UC Berkeley naturally infested board study (Table 2) were probably due more too intensive drilling and thoroughness of treatment rather than residual activity of the AI.

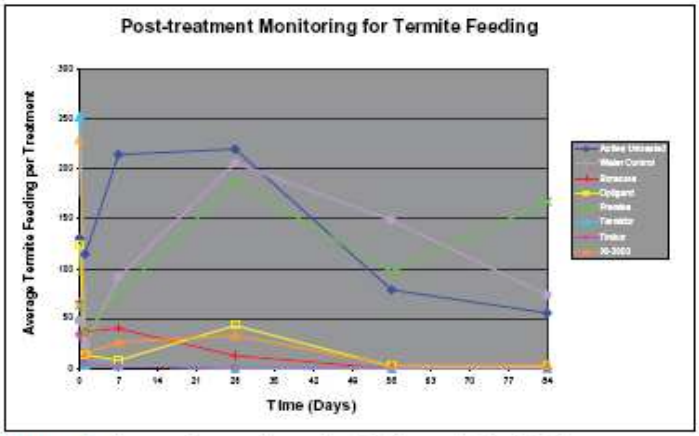

Figure 1. Average drywood termite feeding activity (feeding counts per min) as measured by a Tracker device for six products plus and untreated checks. Each data point represents the mean of three replicate treatment boards. Each board had one three one-minute recording taken for every 18 inches of board length. Termite feeding activity was taken pre-treatment and at seven days, one month, two months, and three months post-treatment.

Additional laboratory and field studies are underway; however, results thus far suggest care must be taken when considering the product, application technique, and detection equipment when using local treatments for drywood termite control.