Termiticide Field Tests Continue Moving Forward

An annual report from USDA labs.

BRAD KARD,
Principal Research Entomologist

Termiticide tests continue to be installed and maintained in Arizona, Florida, Mississippi and South Carolina, which are the Forest Service's main termite biology and control research sites. Liquid termiticide soil treatments to form an insecticidal or repellent barrier against subterranean termites continue as the most widely used method used by pest control operators (PCOs) to protect wooden structures (Kard 1997).

Field tests with existing and candidate termiticides are especially important in light of the United States Environmental Protection Agency's (EPA's) Pesticide Regulation (PR) Notice 96-7, Oct. 1, 1996. This is a very interesting document that I recommend to all PCOs.

One of several issues addressed by this PR Notice is "minimum product performance of termiticide treatments." The PR Notice is too extensive to reproduce here, but concerning termiticide performance it states that "soil treatment termiticide products should demonstrate efficacy for at least five years against termites." The EPA also "believes that registration of a product demonstrating less than five years of efficacy for control of termites is generally not appropriate from a safety or efficacy standpoint, considering the costs of treatment and the potential damage that could occur." The continuing importance of effective termiticides and ongoing research is apparent here.

Several termiticides are currently registered by the EPA for use under and around wooden structures. Also, cyfluthrin and deltamethrin have been effective in field tests and may soon complete EPA registration. Results of field tests through the end of 1997 are provided in the accompanying table.

In U.S. field sites, termiticides are evaluated using several different concentrations. Results from these tests are provided to the EPA as part of the registration process. Forest Service tests determine the years-of-effectiveness of currently marketed and potentially new termiticides as treatments to soil under long-term field conditions. The ability of subterranean termites to penetrate termiticide-treated soil to attack pine blocks or boards is evaluated for at least five years, but tests often run much longer. Annual evaluations continue for as long as a termiticide remains an effective barrier. However, when termites penetrate treated soil and attack the wood in 50 percent or more of the replicates of a particular treatment, that treatment is no longer evaluated at that test site.

In standard ground-board and concrete-slab tests in the U.S., termiticides provided varying years of subterranean termite control, depending on rates applied to the soil and test site location. Years of 100 percent control (as of November 1997) provided by each currently marketed termiticide active ingredient, applied at highest label rates under concrete slabs in our four primary test sites are: chlorpyrifos 1.0 percent (Dursban TC, Equity, Tenure), six to 12 years (1971 four-site test), 21 years (1967 Mississippi test); cypermethrin 0.5 percent (Demon TC, Prevail FT), four to 12 years; permethrin 1.0 percent (Dragnet FT), five to 15 years, (Torpedo, Prelude), three to 17+ years; fenvalerate 1.0 percent (Tribute), six to 12 years; bifenthrin 0.125 percent (Biflex TC), two to 11+ years. Cyfluthrin (Tempo 2 TC) at 0.5 percent has been 100 percent effective for more than 10 years, the length of this test to date. Deltamethrin EC at 0.125 percent has provided four to more than nine years of 100 percent control, and should last longer at the 0.25 percent concentration.

Methods

In each test site, an experimental area is established that contains 10 blocks of land (each 35-by-35 feet), with each block subdivided into 49 plots (each five-by-five feet). Each termiticide treatment is replicated once in each block (one treatment per plot) in a randomized complete-

Number of years that termiticides have been effective against native United States subterranean termites in concrete-slab (CS) and ground-board (GB) field tests through 1997

LOCATION AND PERCENT CONTROL

YEARS OF CONTROL AT EACH PERCENT

Termiticide & percent [AI]**	Test Method	Arizona 100 90 80 70 60 50	Florida 100 90 80 70 60 50	Mississippi 100 90 80 70 60 50	South Carolina 100 90 80 70 60 50
Chlorpyrifos (1971)†					
0.5	CS	4 2 → → 2 →	7 → 1 1 1 →	3 → 4 → → 1*	7 11 → → 1*
1.0	CS	6 → 2 → → →	9 4 4 1 → 1*	11 4 → 1 → →	12 → → 2 → 1*
1.0	GB	3 → → - 1 →	3 → 1 → 1 →	2 1 → 1 → →	6 → → → → →
1.0	GB	2 2 → 1 → 1*	7 → → → → →	4 → 2 → 1 →	8 1 → → → 1*
...	GB‡	— — — — — —	- - - - - -	5 → 1 → 1 →	- - - - - -
1.0	CS‡	— — — — — —	— — — — — —	21 3 2 → 4+ —	— — — — — —
Cypermethrin (1982)		1 3 1 2 → 1*	1 1 1 2 1 1"	1 2 → 1 → →	2 → 1 1 → →
0.255	CS	4 → 1 → → 1* 1*	11 2 1 1+ — —	3 2 1 → → 1*	4 → → → → 1*
0.5	CS	8 2 → 3 2+ — *	5 5 2 3+ — —	7 7 1+ — — —	12 → → 3+ — —
1.0		5 1 → → → → 3	8 7+ — — — —	6 9 + - - - -	12 3+ — — — —
1.0	GB		5 → 2 → 1 1*	5 → 1 → 1 →	5 1 → 1 2 1*
Fenvalerate (1978)					
0.25	CS	8 2 1 4 → 1*	1 1 3 1 → 1*	2 1 → 1 → 1*	3 2 1 1 1 1*
0.5	CS	12 1 2 → 1 →	3 4 1 7 1 1*	7 → 2 → 1 1*	4 4 4 2 2 1*
	CS	12 → → 1 6 + -	6 13+ — — — —	10 1 → 2 2 1*	6 7 → 1 5+ —
:::	GB	7 1 1 → → 1*	4 1 3 → 1 →	4 → → 1 1 →	6 1 → → 1 →
Permethrin - Dragnet FT (1978)					
0.25	CS		2 → 2 → r 2	1 1 → → 1 →	→ → → 2 1 →
0.5		8232-r-t 13 6+ — — — —	4 → 2 13+ — —	5 1 → → 1 →	5 3 1 → → 1*
	CS	15 → 4+ — — —	15 4+ — — — —	5 3 2 1 → 1*	10 1 5 1 → 1*
1.0	GB	9 2 → 3 1 1*	6 → 3 → → →	2 1 → → → →	1 3 → → 1 →
Permethrin - Torpedo (1980)		9 → 1 2 → 1*	3 4 2 2 2 - t	2 → → 1 → 1*	→ → → 1 1 1*
1.05	CS	1 1 2 3 1+ — —	6 3 4 → 4+ —	4 1 → → 1 →	1 3 3 → 1 →
0.5	GB	4 17+ — — — → — → —	17+ — — — — —	3 4 1 1 2 →	6 1 2 1 2 1*
...		4 → 1 → → 1*	4 → → 1 → →	1 → 1 → → →	1 → → → → →
1.0	GB	8 1 → → → →	5 → 1 1 → 1*	2 → → → 1 1*	1 → → → → →
Bifenthrin - Biflex TC (1986)					
0.031	CS	0 9 2 + - - -	4 7 + - - - -	2 3 1 5 + - -	2 2 3 4 + - -
0.062	CS	11+ — — — — —	11+_ — — — —	7 → 2 1 1+ —	1 0 1+ — — — —
0.125	CS	10 1+ — — — —	9 2 + - - - -	2 5 4 + - - -	11+ — — — — —
0.25	CS	11+ — — — — —	, , +- — — — —	, , +- — — — —	11+ — — — — —
0.5	GB	6 5 + - - - -	11+ — — — —	11+ — — — —	11+ — — — — —
0.5		10 1+ — — — —	11+ — — — —	11+- — — — —	8 3 + - - - -
Cyfluthrin - Tempo TC (1987)					
0.125	CS	4 2 → → 3 →	9 1+ — — — —	2 2 5 1+ — —	4 3 3 + - - -
0.25	CS	1 0 + - — — — —	1 0 + - — — — —	6 2 2 + - - -	, 0 + - - — — —
0.5	CS	6 01 → → 1-1 —	10+ — — — — —	10+ - — — — —	10+ — — — — —
0.5	GB	5(2 → 1 → → —	1 0 + - — — — —	10+ — — — — —	10+ — — — — —
	GB	**	6 1 → 2 1+ —	5 → 1 1 → 1*	6 3 - t - t 1+ —
1.0			7 3 + - - - -	4 2 4+ — — —	7 3+ — — — —
Deltamethrin - EC Formulation (1988)					
0.05	CS	1 → 1 3 → →	3 1 3 2 + - -	3 → 1 → → 1*	2 2 → → 1 1*
0.125	CS	5 → → 3 → 1+	9 + - - - - - _	4 → 2 1 1 →	7 2+ — — — —
0.5		9+ — — — — —	9+ — — — — —	9+ - - - - -	9+ — — — — —
1.0	CS	9+ — — — — —	. . . . . .	9+ - - - - -	9+ — — — — —
0.5	GB	2 5 1 1+ — —	. . . . . .	2 4 → 2 1+ —	9+ — — — — —
1.0	GB	9+ — — — — —	9+ — — — — —	2 7 + - - - -	9+ — — — — —

Non-treated monitoring plots (See note below)

Percent attack on wooden blocks and boards in plots without termiticide treatments

	Test Method	Arizona	Florida	Mississippi	South Carolina
	CS	40 to 80 percent	70 to 100 percent	50 to 70 percent	50 to 100 percent
	GB	20 to 90 percent	80 to 100 percent	80 to 90 percent	40 to 100 percent

* Evaluations stopped after one year at 50 percent effectiveness.
**The active ingredient (AI) concentration in the termiticide dilution applied to the soil.
† Year test initiated.
‡ Initial 1967 test in Mississippi only.

NOTE: An arrow indicates a greater-than-10-percent loss in termite control since the preceding evaluation.
Dashes represent termite control percentages not yet observed.
A "+" after a number indicates that control did not decline below the indicated percent as of the most recent evaluation.
Percent attack on wood in non-treated monitoring plots is for 1996-1997. Wood in all original non-treated control plots has been destroyed, thus, non-treated monitoring plots are used to assess continuing termite activity.

Mention of a trade name does not imply Forest Service endorsement of any specific brand of termiticide over another.

block design. Termiticides are evaluated using both ground-board and concrete-slab methods (Beal 1980; Beal et al. 1989).

Aqueous formulations of termiticides are applied to the soil at several active-ingredient concentrations, usually ranging from 0.00 percent (water-only controls) to 1 .O percent by weight, at pre-construction volumes. Each block of land contains at least one concrete-slab and one ground-board treatment of each concentration, for a minimum of 10 replicates of each treatment at each test site.

The concrete-slab method simulates a poured concrete foundation. To establish a test plot, leaves and debris are removed to expose soil in a square area 24 inches on a side. A 2 1 -inch-square wooden frame constructed of one-inch-by-one-inch spruce strips is placed in the center of the cleared area, and a triangular trench two-inches-deep and two-inches-wide at the top is dug around the inside of and adjacent to the frame. A square metal frame, 17 inches on a side by four-inches-high, is then centered within the wooden frame, and termiticide is applied evenly to the soil surface within the metal frame.

The metal frame is removed and a vapor barrier (six mils thick, 2 1 -inch-square plastic sheet) is placed over the treated area. A seven-inch plastic pipe, four inches in diameter, is placed upright on the vapor barrier in the center of the treated area, and concrete is poured over the vapor barrier until it reaches the top of the wooden frame. The concrete is finished with a trowel, resulting in a smooth-surfaced slab.

After the concrete hardens, the vapor barrier at the bottom of the tube is cut out to expose treated soil. Care is taken not to disturb the treated soil when removing the circular piece of vapor barrier. A two-by-three-by-four-inch pine-sapwood block is placed inside the pipe and directly on the treated soil. The tube is capped to reduce loss of moisture and to preclude rain and sunlight from affecting the termiticide.

The ground-board method is similar to the concrete-slab method except that no concrete slab or vapor barrier is used. A one-by-six-by-six-inch pine-sapwood board is placed on the termiticide-treated soil and weighted down with a brick. The treated area remains exposed to weathering.

For termiticides to be effective for as long as possible, they must be applied as a continuous barrier in the soil.

The ability of *Reticulitermes* sp. or *Heterotermes aureus* (SW desert) to penetrate termiticide-treated soil to attack pine blocks or boards is evaluated for at least five years. Decayed blocks and boards are replaced during annual evaluations.

Discussion

The following examples help interpret the Table. In Mississippi, 1 .O percent fenvalerate placed under concrete slabs in 1978 provided 100 percent control of subterranean termites for 10 years. Control then declined to 90 percent during the 11 th year, where it remained for one year before declining further to 70 percent. It remained at 70 percent for two years before falling to 60 percent effectiveness, where it remained for two more years. By the next year, it declined to 50 percent.

In South Carolina, 1 .O percent permethrin (Torpedo) under concrete slabs was 100 percent effective in preventing penetration of subterranean termites through treated soil for six years. Control then declined to 90 percent during the seventh year, where it remained for one year before declining further to 80 percent. It remained at 80 percent for two years before declining to 70 percent, where it remained for one year. The next year it declined to 60 percent, where it remained for two years before declining to 50 percent, where it remained for at least one year. The asterisk after the (1) indicates that evaluation of this treatment stopped after one year at 50 percent. Thus, the total number of years that 1 .0 percent permethrin (Torpedo) remained at 50 percent control was not recorded. Other asterisks found in the table indicate the same situation. Arrows between different percentage-of-effectiveness levels represent a greater-than-lo-percent loss in termite control since the previous evaluation. A dash in the table represents termite control percentages not yet observed.

Because termiticide field tests are installed during different years, a termiticide reported as 100 percent effective for a certain number of years is not necessarily less successful than one listed as 100 percent effective for a longer period. The periods of testing are simply different. It should be recognized that to achieve termite control for the number of years indicated by research results using currently marketed termiticides, there is only a narrow range of safety for creating an effective barrier in the soil. For termiticides to be effective for as long as possible, they must be applied as a continuous barrier in the soil, preferably at their highest label rates. PC

References

Beal, R H. 1980. New materials for termite control Pest Control 48(11), 46-54

Beal, R H., J. K Mauldin and S C. Jones 1994. Subterranean termites—their prevention and control in buildings Home and Garden Bull. No 64, Forest Service-USDA, Washington, DC

Kard, B. M. 1997 Termite control is still a tough science Pest Control 65(2), 66-68

Brad Kard is a principal research entomologist at the Forest Service United States Department of Agriculture, Starkville, Miss.

Stainless Steel Mesh

An Alternative Termite Barrier?

BY BRAD KARD
Principal Research Entomologist

Termiticides used today are safe and pose little hazard to the environment or the people who depend on them to protect their homes and buildings. However, it is reasonable to investigate alternatives to insecticides for the control of subterranean termites. Some people are extra-sensitive to insecticides or would prefer to use non-insecticidal means to control termites.

In Australia, a high-quality, stainless steel mesh has been used with success beneath wooden structures to physically exclude subterranean termites, and thus, protect the structure from feeding damage. This mesh has been placed under many new homes and commercial buildings as a preconstruction barrier installation. Methods for post-construction application have also been developed. The success in Australia warranted testing of this material in the United States to evaluate its efficacy against subterranean termites.

Possible corrosion of the stainless steel mesh was also considered by the developer. Corrosion tests with stainless steel have been conducted worldwide and are documented in several publications (M. Romanoff, National Bureau of Standards, Circular 579, April 1957, U.S. Government Printing Office). The oxide layer on T-304 stainless steel, the grade designation of the mesh used in this test, prevents prolonged corrosion.

Tests conducted in Australia showed that T-304 stainless steel mesh placed in the most aggressive Sydney soils was not corroded even after 11 years (D. Hargreaves and C.B. Rolfe, Corrosion Australiasia 8(1): 10-13, 1983). In an ocean-side environment, there was no significant corrosion of T-304 stainless steel after 16 years. The application of stainless steel mesh under concrete floors and cavity walls may have a useful life of several decades, as claimed by the owners of the product, Termi-Mesh Australia.

Stainless steel mesh tests were installed in Arizona, Florida, Mississippi and South Carolina during 1993. Three methods were used to test its effectiveness as a barrier for preventing subterranean termites from reaching and attacking southern yellow pine blocks: (1) stainless steel mesh sleeve; (2) concrete block; and (3) concrete slab. Each method was replicated 20 times in each test site, resulting in 80 replicates per test method. In the sleeve method, an 18-inch-long, two-inch-by-four-inch pine board has a sleeve of stainless steel mesh wrapped around one end and approximately 15 inches up its length. The "sleeved" end is inserted vertically into termite-infested soil about nine inches deep.

The concrete block method consists of a 15-by-15-inch square by eight-inch-high concrete building block that is wrapped underneath one open side and halfway up around its four walls with stainless steel mesh. The block is placed horizontally on the soil and capped with a square Plexiglas lid. Inside are two pine sapwood blocks on top of the mesh. A seven-inch-tall by four-inch-diameter PVC pipe is vertically inserted through carefully cut slits in the center of the mesh so its open bottom contacts the soil. The mesh is sealed around the PVC pipe with a stainless steel hose clamp. A pine sapwood block is placed inside the pipe and in contact with the soil, and the pipe is capped.

For the concrete slab test, a 24-by-24-inch square piece of mesh is placed on the soil and covered with standard polyethylene vapor barrier. A seven-inch-tall by four-inch-diameter PVC pipe is vertically held on top of the vapor barrier and a 2 1 -by-2 1 -inch square concrete slab, approximately two inches thick, is poured over the vapor barrier and around the pipe. The vapor barrier has a pre-cut, four-inch-diameter hole in its center that is located directly under the PVC pipe opening. After the concrete hardens, a pine sapwood block is placed inside the PVC pipe on top of the exposed stainless steel mesh, and the pipe is capped. Control plots were installed identical to the three test configurations, but without stainless steel.

After four years of testing, stainless steel mesh remains 100 percent successful as a barrier to subterranean termites. Termites did not penetrate through the mesh, while non-protected wood in control plots was severely damaged. Efforts to market this product in the U.S. are under way, but moving slowly at present. Technicians will require training on proper installation. Tests with this promising new non-toxic termite exclusion barrier will continue for many years in our field sites and will be reported on after future evaluations. PC

Stainless Steel Mesh Field Tests (Four-year summary through 1997)

Test Method	Percent Attack on Wooden Blocks															
	FL				AZ				MS				SC			
	1994	1995	1996	1997	1994	1995	1996	1997	1994	1995	1996	1997	1994	1995	1996	1997
SS-Mesh Plots																
Concrete Block	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Concrete Slab	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Sleeve	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Control Plots																
Concrete Block	90	100	100	100	35	40	65	80	95	100	100	100	90	95	100	100
Concrete Slab	95	95	100	100	45	65	95	100	95	100	100	100	90	95	100	100
Sleeve	90	100	100	100	50	70	85	95	100	100	100	100	100	100	100	100

@Reprinted from PEST CONTROL, February 1998 AN ADVANSTAR PUBLICATION Printed in U.S.A.