TWENTY-SEVEN YEARS OF TERMITE CONTROL TESTS

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THE MAIN SITE for evaluating soil treatments to protect buildings from subterranean termite attack is the U. S. Department of Agriculture's Forest Service Laboratory at Gulfport, Mississippi. Tests begun there in 1944 are among the most comprehensive in the world. This paper describes the tests and gives the currently recommended chemical treatments.

Methods

The long-term studies were established on the sandy soil 20 miles north of Gulfport. In 1959 some test units were established on clay soil in northern Mississippi. The two standard tests in these studies are ground-board and stake tests.

Ground-board tests simulate the treatment of soil prior to pouring concrete slabs. All vegetation is removed from a 17-inch square of soil; then the chemical is sprinkled evenly over the soil surface. After the chemical has soaked in, a 1- by 6- by 6-inch untreated sap pine board is laid flat on the ground in the center of the treated area so that termites must penetrate the treated soil before they can attack the board.

Stake tests are designed to simulate application of chemicals in trenches around building foundations. Two cubic feet of soil are removed to make a hole 15 inches in diameter and 19 inches deep. The soil is treated with the chemical as it is replaced in the hole; then a 2- by 4- by 18-inch untreated sap pine stake is driven to a depth of 12 inches in the center of the treated soil.

Treatments are considered a failure when termites penetrate the treated soil and attack the boards or stakes.

Results

Treatments effective in one test method are also effective in the other method; likewise, ineffective treatments fail in both methods. Many chemicals (other than chlorinated hydrocarbons) were installed in both ground-board and stake tests from 1946 to 1952 and are no longer effective or recognized as acceptable for use as soil treatment (Tables 1 and 2). Some of the more recognizable ones and the length of their effectiveness include creosote, 3 years; pentachlorophenol, 4 years, sodium arsenite, 5 years; arsenic trioxide, 5 years; copper sulphate (dry crystals), 5 years; lead arsenite (water sus-

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Table 1.—Soil treatments that have been evaluated in ground-board tests established in 1946-52, in southern Mississippi but are no longer recognized as satisfactory treatments

Chemicals	Formulations	Dosage rate	Effective period
		pt/sq ft	Years
Acetylene tetrachloride	Undiluted	1	3
Copper ammonium fluoride	2% cu (water)	1	2
Creosote	10 different formulations	½	2
Creosote	(oil)	1	2
Creosote	25% volume (kerosene)	1	3
Pentachlorophenol	5% (oil)	1	3
Pentachlorophenol	5% (heavy oil)	1	4
RH 195/acetylene tetrachloride	6%	1	3
Sodium arsenite	10% (water)	1	5
Arsenic trioxide	20%	½	5
Sodium fluosilicate	5% (dry powder)	4 oz/sq ft	3
Kerosene check	—	1	2
Gasoline check	—	1	—1
Methoxychlor	5% (oil)	½	4
Toxaphene*	8% (water)	1	4

* Toxaphene in #2 fuel oil is still giving 100% control at 1pt/sq ft and 90% control at ½ pt/sq ft after 22 years.

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Table 2.—Soil treatments that have been evaluated in standard stake tests established in 1946-52 in southern Mississippi but are no longer recognized as satisfactory treatments

Chemicals	Formulations	Dosage rate	Effective period
		cu ft	Years
Copper naphthenate	2% copper (kerosene)	2 gal/10	2
Copper sulfamate	12% (water)	3.75 gal/10	4
Copper sulphate	Undiluted (dry crystals)	10 lb/10	5
Copper sulphate	12% (water)	5 lb/10	1
Chlorinated nitrotoluene	22.5% in fuel oil	2.5 gal/10	3
Lead arsenite	Undiluted (dry powder)	½ lb/10	6
Lead arsenite	24% (water suspension)	2½ gal/10	3
Hexachloroethane	6% acetylene tetrachloride	2½ gal/10	2
Monochloronaphthalene	5% (kerosene)	2½ gal/10	2
Monochloronaphthalene	10% (kerosene)	2½ gal/10	3
Orthodichlorobenzene	25% volume F. O.	3.2 pt/	5
Sodium dinitro-ortho-cresolate	25% by volume (water)	3.75 gal/10	1
Sodium meta arsenite (70% arsenic trioxide)	10% (water)	3.75 pt/	14
Sodium meta arsenite (70% arsenic trioxide)	16% (water)	3.75 pt/	22
Tetrachlorobenzene unrefined	14% (oil)	2½ gal/10	8
refined	15% (oil)	2½ gal/10	6
Trichlorobenzene	25% volume (oil)	2½ gal/10	8
Trichlorobenzene	25% volume (water)	3.75 gal/10	7
Trichlorobenzene plus creosote	1-1-6 oil	4 gal/10	7
TX still residue (petroleum by-product)	Undiluted	2½ gal/10	2
Xanthone 95% pure dry	Undiluted	2½ lb/10	-1

Table 3.—Soil treatments that are still 100% effective in ground-board tests established in 1948-52 in southern Mississippi

Years in test as of 1971	Chemical	Concentration	Dosage rate
		%	pt/sq ft
23	Chlordane (tech.) in #2 fuel oil	1	½
		1	1
		2	½
		2	1
	Chlordane (tech.) in water emulsion	2	½
		2	1
22	Aldrin (actual) in water emulsion	¼	1
		½	1
		1	1
	Dieldrin (actual) in water emulsion	¼	1
		½	1
		1	1
19	Heptachlor (actual) in water emulsion	1	½
		2	½

Table 4.—Soil treatments that are still 100% effective in 1971 in standard stake tests established in 1951 in southern Mississippi

Chemical	Concentration	Dosage rate
	%	Gal/10 cu ft
Chlordane (tech.) in #2 fuel oil	2	4
Aldrin (actual) in water emulsion	½	3¾
	1	3¾
Dieldrin (actual) in water emulsion	1	3¾
	2	3¾

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pension), 3 years; orthodichlorobenzene, 5 years; and sodium meta arsenite, 22 years. The sodium meta arsenite is much too toxic to be used safely. All tests with these materials have been closed.

Some treatments with aldrin, chlordane, dieldrin, and heptachlor are still giving 100% control after 19 to 23 years (Tables 3 and 4). The lowest effective concentration of each chemical has been increased in registered control recommendations to provide a margin of performance for effective treatment when climate, soil type, and termite species vary from those in southern Mississippi (Johnston and Osmun 1960). Concentrations of 1% chlordane and ½% aldrin, dieldrin, and heptachlor have been recommended and registered for subterranean termite control.

Though much lower concentrations of the insecticides are giving several years of protection, the authors believe that the consumer will benefit by using the above concentrations. The following materials, applied at a rate of 1 gal/10 sq ft, as recommended by the U. S. Dep. of Agri. (Anon. 1968), will provide protection from termites for many years: chlordane—at least 23; aldrin and dieldrin—22; and heptachlor—19. These chemicals will remain in test until they fail to control termites.

Soil samples taken in and near the areas treated in southern Mississippi in 1948-1952 were analyzed for chemical residues. Results show that the insecticides have moved only a few inches during 18-22 years of exposure to the elements (Smith 1968, 1969). Since in practice they are placed on the soil under buildings where there is a minimum of weathering, erosion, or other disturbance, the treatment presents a minimal hazard to man.

Control obtained with insecti-

cides applied in granular form in ground-board tests are shown in Table 5. All granules containing 1/32% dieldrin and 1/16% aldrin, chlordane, and heptachlor are still giving 100% control after 12 years; those with less insecticide failed earlier.

The stake tests started in 1964 where the chemicals were applied in the granular form in layers were carefully examined after 6 months and it was found that termites were able to penetrate between layers of applied granules and attack the bait stakes. Results show that granules should be well mixed into the soil rather than applied in layers.

Comparison of results by analysis of variance with different volumes of liquid carrier indicates effectiveness is not greatly altered by the amount of water used, but is more closely related to the amount of actual insecticide placed in the soil. For ex ample, treatments with concentrations of 1/512, 1/256, and 1/128% aldrin, applied at rates of 4, 2, and 1 pt/sq ft of soil, contain the same quantity of toxicant, and all 3 treatments have given protection from termite attack for about the same length of time.

The 1959 ground-board studies established in northern Mississippi gave somewhat different results from those obtained from the studies in southern Mississippi. The lowest concentrations still giving 100% protection are: Sumter clay soil—aldrin ¼% and chlordane, dieldrin, and heptachlor ⅛% (all at 1 pt/sq ft); Sharkey clay—dieldrin ¼% and aldrin, chlordane, and heptachlor ½% (all at 1 pt/sq ft); Rumford sandy clay loam in southern Mississippi — aldrin 1/32% at 4 pt/sq ft, chlordane ⅛% at 2 pt/sq ft, and dieldrin and heptachlor 1/32% at 2 pt/sq ft. The BHC treatments included in the study on the Sumter clay soil have all been penetrated by termites and most of them are no longer in test.

Among the chemical applications evaluated as termiticides in ground-board tests beginning in 1959, Telodrin 1/32% at 2pt/sq ft and Di-chlordane ¼% at 1 pt/sq ft are giving 100% control after 11 years. All lower concentrations of Telodrin (1/2048-1/128%) and Di-chlordane (1/64-⅛%), as well as all Kepone treatments, have had 1 or more attacks by termites.

Many of the studies are still in progress and will be continued as long as any of the applications of any of the insecticides give termite control.

The pesticides reported on and recommended here were registered for the use described at the time this manuscript was prepared. Since the registration of pesticides is under constant review by State and Federal authorities, a responsible state agency should be consulted as to the current status of these pesticides.

Table 5.—Granular insecticides applied in ground-board tests in 1958 in southern Mississippi

Formulation (approx. % by wt)	Weight of toxicant applied[1]	Ground boards undamaged by termites after indicated years											
		1	2	3	4	5	6	7	8	9	10	11	12
Aldrin (actual)	**g/sq ft**	**Percent**											
1/64	0.074	100	100	80	70	40							
1/32	.148	100	100	100	100	80	80	80	60	60	40		
1/16	.296	100	100	100	100	100	100	100	100	100	100	90	90
1/8	.592	100	100	100	100	100	100	100	100	100	100	100	100
Dieldrin (actual)													
1/64	.074	100	100	100	100	90	80	80	70	70	50		
1/32	.148	100	100	100	100	100	100	100	100	100	90	90	90
1/16	.296	100	100	100	100	100	100	100	100	100	100	100	100
Chlordane (technical)													
1/64	.074	100	90	80	70	60	50						
1/32	.148	100	100	90	90	90	60	50					
1/16	.296	100	100	100	100	80	70	60	60	50			
1/8	.592	100	100	100	100	100	100	100	100	100	100	100	90
1/4	1.184	100	100	100	100	100	100	100	100	100	100	100	100
Heptachlor (actual)													
1/64	.074	100	100	100	100	60	50						
1/32	.148	100	100	100	100	90	80	70	50				
1/16	.296	100	100	100	100	100	100	100	100	90	90	90	70
1/8	.592	100	100	100	100	100	100	100	100	100	100	100	100

[1]/The amounts shown in this column are equivalent to amounts of toxicant that are applied for each percentage at 1 pt/sq ft in water emulsion.

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