TERMITICIDE FIELD TEST REPORT: NEW TERMITICIDES & EMERGING TECHNOLOGIES

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Termiticides

Testing at our nationwide field sites determines the years-of-effectiveness of currently marketed and potentially new termiticides as treatments to soil under long-term field conditions. Several new termiticide candidates and formulations have been placed in the field during the past four years and will be reported on after they complete five years of testing.

Ground-board and Concrete-slab Tests

In standard ground-board and concrete-slab tests in the United States, termiticides provide varying years of subterranean termite control depending on rates applied to the soil and test site location. Years of 100% control provided by currently marketed termiticides plus two candidates are provided in accompanying handouts (Table 1). To be sure you are correctly interpreting the accompanying tables, read the following examples and follow along on Table 1. For example, in Mississippi, 1.0% fenvalerate placed under concrete slabs in 1978. This provided 100% control of subterranean termites for 10 years. Control then declined to 90% during the eleventh year, where it remained for one year before declining further to 70%. It remained at 70% for two years before falling to 60% effectiveness where it remained for two more years. By the next year it declined to 50%.

In South Carolina, 1.0% permethrin (Torpedo) under concrete slabs was 100% effective in preventing penetration of subterranean termites through treated soil for six years. Control then declined to 90% during the seventh year, where it remained for one year before declining further to 80%. It remained at 80% for two years before declining to 70%, where it remained for one year. The next year it declined to 60%, where it remained for two years before declining to 50% where it remained for at least one year. An asterisk after "1*" indicates that evaluation of that treatment stopped after one year at 50% in that test site. Thus, the total number of years that 1.0% permethrin (Torpedo) remained at 50% control was not recorded. Other asterisks in the table indicate the same situation. Arrows between different percent control levels represent a greater than 10% loss in termite control since the previous evaluation. A dash in the table represents termite control percentages not yet observed. A cross "†" after a number means the test ended at that specific site after the number of years indicated. After many years a test may be terminated even if a treatment has not declined to 50% or less control. A termiticide reported as 100% effective for a specified number of years is not necessarily less successful than one listed as 100% effective for a longer period. The testing periods are simply different.

Fipronil Field Tests Complete Six Years in October 2000 (Termidor®)

Initial fipronil field tests were installed during 1994 using 80% active ingredient (a.i.) water dispersible granule (WDG) formulation. Table 2 (handout) provides 6-year results from Florida, Arizona, Mississippi through 2000, and 5-year results for South Carolina through 1999 (SC 2000 evaluations due in October). Because termite foraging in the water-only control plots located adjacent to fipronil treated plots appears to be negatively affected by this insecticide, additional field tests with newer formulations have been installed. These tests place each fipronil concentration into its own separate group of plots to avoid possible overlapping effects of one fipronil concentration on termites in another plot with a different concentration. Termite foraging activity in these new test plots will also be evaluated. Overall, fipronil has been effective at several different application rates.

Seven-Year Premise® Field Tests (through 1999)

Premise (imidacloprid) under concrete slabs provided control of native subterranean termites in the four main test sites over five years of testing (1992-1997), although some termite penetrations through treated soil occurred in Mississippi. During test years six and seven, there was a noticeable increase in termite activity in the test plots in Mississippi, but comparatively little in Arizona, Florida, and South Carolina (Tables 3 and 3a).

Imidacloprid was tested at several concentrations, each applied to the soil surface at standard sub-slab preconstruction volumes. Additionally, water-only control plots were installed for comparison. Standard concrete-slab and ground-board test methods were used, but the field plot arrangement was reconfigured. Unlike standard field tests where different concentrations are applied singly to soil in side-by-side plots in a group of test plots, each tested concentration of imidacloprid was placed in a separated group of 10 test plots. Different imidacloprid concentrations were not placed in side-by-side plots in a group, thus reducing possible overlapping effects and false readings of one rate on termites in another plot with a different rate that might occur if side-by-side plots in a group were treated with different concentrations.

Unlike standard field research plots that are removed from a test when penetrated by termites, Premise plots that sustain termite penetration and attack to wood receive fresh wood and remain in the test to evaluate changes in termite activity over time. Severity of damage to wood attacked by termites is rated yearly using the American Society for Testing and Materials numerical grading system: 10=sound, no attack by termites; 9=trace of attack; 7=moderate attack; 4=heavy attack; 0=failure from termites (Annual Book of ASTM Standards. 1986. ASTM, Philadelphia, PA; Table 3b).

At application concentrations ranging from 0.05% to 0.40% active ingredient (a.i.), imidacloprid treatments under concrete slabs in Arizona, Florida, and South Carolina remained 100% effective during the first five years of testing. In Mississippi, termites first penetrated soil during the third test year (0.05% a.i. or greater), when wood in three of the 0.05% a.i. plots, one each of the 0.10% a.i. and 0.20% a.i. plots, and two of the 0.25% a.i. plots sustained termite attack. However, because termites must contact imidacloprid by tunneling in the non-repellent treated zone, it is expected that some termites will reach wood on top of the treated soil before imidacloprid takes effect. Not all penetrated plots had active termites at the times of evaluation (Table 3a).

To interpret the significance of termite penetrations through plots, it is important to answer at least two questions: (1) Once plots were penetrated, did termites continue to actively feed and cause increasing damage to wood? (2) How severe was the termite damage to wood in penetrated plots? In Mississippi during 1995, three 0.05% a.i. concrete slab plots were penetrated, and one plot contained active termites (Table 3a). In the two other plots no termites were present on the soil surface or wood at the time of evaluation. In 1996, these two 0.05% a.i. concrete slab plots had been penetrated again, but no active termites were present on the soil surface or the damaged wood. The one 0.05% a.i. plot penetrated during 1995 was free of termites at the 1996 and 1997 evaluations. In 1997, termites were active in one of two other penetrated 0.05% a.i. concrete-slab plots. During 1998 and 1999, several more plots in Mississippi, and a few plots in Arizona, Florida, and South Carolina were penetrated by termites. Termites were often active in the Mississippi plots (Tables 3 and 3a).

It is important to compare termite penetrations through treated plots with the severity of damage to wood. ASTM damage ratings provided in Table 3b are averages for wood in 10 concrete-slab or 10 ground-board plots, including both non-penetrated plots (sound wood) and penetrated plots (damaged wood). Thus, the ASTM 10.0 ratings for plots that received no penetration, plus plots that sustained trace, moderate, or heavy ASTM damage ratings are included in these averages.

In ground-board plots, several penetrations occurred in all sites except Arizona, and damage generally increased in severity as the tests progressed (the lower the average ASTM number the greater the damage). Because the imidacloprid treatments are exposed to the weather in ground-board tests, chemical breakdown can be expected to occur more rapidly than in the protected concrete-slab environment, and earlier penetrations by termites are expected. Generally, this occurs in termiticide field tests.

In Mississippi, average damage to wood caused by termites in imidacloprid-treated concrete-slab plots generally remained steady between 1995 and 1997 (Table 3b). Termites were not always found on wood in penetrated plots, but they caused damage to wood before they departed. At the 0.05% a.i. and 0.10% a.i. rates, 11 concrete-slab plots were penetrated from 1995 through 1997, and damage to wood was trace-to-moderate in 1995, but was trace-to-heavy in 1996, 1997, and 1998. However, of the two plots (one 0.05% a.i. and one 0.10% a.i.) with heavy damage to wood in 1997, only the 0.05% a.i. concrete slab plot contained active termites, with the 0.10% a.i. concrete slab plot showing no activity. In 0.15% to 0.25% a.i. plots that were penetrated from 1995 through 1997, damage to wood was trace to heavy, and termites were active in 8 of the 10 plots penetrated. Damage was more severe in the penetrated plots during 1999, the seventh year of testing (Tables 3a and 3b). Overall, imidacloprid was effective under concrete slabs during the first five years of field tests, and has done well in AZ, FL, and SC for seven years, the duration on the test through 1999.

Stainless Steel Mesh Field Tests

In Australia, a high quality stainless steel mesh has been used with success beneath wooden structures to physically exclude subterranean termites, protecting the structure from feeding damage. This mesh has been placed under thousands of new homes and commercial buildings in Australia as a pre-construction installation. Methods for post-construction application have also been developed wherein the mesh can be "glued" to concrete, brick, or other surfaces with a specially developed adhesive. Success in Australia led to testing in the United States.

Corrosion tests with stainless steel have been documented and conducted world-wide (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 these tests, prevents prolonged corrosion. Tests conducted in Australia showed that T-304 stainless steel mesh placed in the most aggressive Sydney soils was not corroded 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. Currently, T-304 stainless steel has been replaced with T-316 stainless steel for mesh production. T-316 stainless steel is the highest grade of non-corrosive stainless steel commercially available and further improves corrosion resistance. Stainless steel mesh installed under concrete floors and inside 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 test methods were used: (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, mesh side down, and capped with a square Plexiglass lid. Two pine sapwood blocks are placed inside the concrete block and on top of the mesh. Additionally, 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 tightly 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 six-mil-thick polyethylene vapor barrier. A seven-inch-tall by four-inch-diameter PVC pipe is vertically held on top of the vapor barrier and a 21-by-21-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 methods, but without stainless steel.

After six years of testing, stainless steel mesh remains 100 percent successful as a barrier to subterranean termites (Table 4). Termites did not penetrate through the mesh, while non-protected wood in control plots was severely damaged. Marketing of this product in the U. S. is underway and about 200 houses, plus three fire stations, three schools, and one police station have been built in the Hawaiian Islands with stainless steel mesh pre-construction installations. Three recently constructed demonstration houses, two in St. Johns County, Florida (St. Augustine; Jacksonville) and one in Franklin, North Carolina, included stainless steel pre-construction installations. Additionally, approximately ten new houses in the Orlando, Florida area have been included stainless steel mesh and several new construction installations are planned. Also, a post-construction stainless steel installation in Hawaii during 1992 has corrected a serious Formosan subterranean termite infestation.

Technicians require training on proper installation, and comprehensive, detailed training manuals are provided to trainees. Forest Service field tests will continue for many years and will be reported on after future evaluations.

Insecticide-Vapor Barrier Combinations

Much interest has been generated concerning commercial vapor barriers that can double as an insecticidal barrier to subterranean termites. Three insecticide-impregnated vapor barriers are currently in field tests: Kordon Blanket (Aventis Environmental Science, USA; commercial in Australia), Termifilm (Cecil Company, France; commercial in France), and Impasse (Zeneca Professional Products, USA; experimental). These vapor barriers are being placed under our standard concrete slab configuration, as well as wrapped around the bottom half of standard construction concrete blocks in the same manner as the stainless steel mesh tests. These tests were installed from 1997 to 1999 and it is too early to provide an evaluation. Updates will be provided after these barriers reach several years in the field.

(Mention of trade names does not imply USDA-Forest service endorsement of any specific brand of termiticide over another)

<u>NOTES</u>: