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Use of a Stainless Steel Mesh to Exclude Formosan Subterranean Termites

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ABSTRACT

Physical barriers are gaining in popularity world-wide as methods of preventing subterranean termite penetration and attack on structures. Sized particle barriers of crushed basalt or granite are approved for use in building construction in Hawaii and Australia. TERMI-MESH, a marine grade 316 steel mesh, was recently developed in Australia and is approved there, and now in Hawaii, for use as a termite barrier. We report results of a one-year field test in Hawaii to evaluate the ability of this steel mesh to prevent penetration by the Formosan subterranean termite, *Coptotermes formosanus* Shiraki (Isoptera: Rhinotermitidae). Nine test units, containing susceptible wood, were placed above-ground under conditions of high termite pressure at three field sites on the island of Oahu, and a tenth test unit was buried at one of these sites. Test units were removed after one year, and examined for termite penetration. Termites did not directly penetrate the steel mesh, nor areas where pipes had been inserted through the mesh, in any of the ten test units. In one of the above-ground units, however, a crack in the bonding cement securing a heavy fold of the mesh to the corner of a concrete block allowed termites into the test unit. In practice, the mesh would not normally be sealed to a corner in this fashion. Thus, a second field test has since been initiated to more accurately simulate use of the bonding cement to secure the mesh in construction situations, and determine whether improvements are warranted. Our results indicate that TERMI-MESH is effective in excluding *C. formosanus*; although, as with other physical barriers, care must be taken in installation to prevent termites from circumventing the barrier.

Key Words: Isoptera, Rhinotermitidae, *Coptotermes formosanus*

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INTRODUCTION

Proper construction techniques, such as isolating wood from the soil, and the use of physical barriers to exclude subterranean termites are practical approaches to preventing termite attack on structures. All too frequently, construction details that are conducive to termite infiltration or to moisture accumulation and fungal decay are incorporated into new buildings under the guise of economy or aesthetics (Dost & Botsai 1990, Tamashiro *et al.* 1990, Verkerk 1990). Certainly, adoption of vigilant construction methods and the use of inert physical barriers such as properly-sized gravel to prevent termite penetration into the structure promises more permanent termite control than is possible with insecticide applications to the soil alone.

In Hawaii, crushed and screened basaltic gravel is marketed as the Basaltic Termite Barrier, or BTB (Ameron HC&D, Honolulu), and has gained wide public acceptance. A similar crushed granite product is marketed in Australia as Granitgard (Granitgard Pty. Ltd., Victoria). Crushed basalt (Tamashiro *et al.* 1987a, 1987b, 1990, 1991), granite (Smith & Rust 1990, French & Ahmed 1993, French 1994, Ahmed & French 1996), quartz and coral sand (Su *et al.* 1991), silica sand (Ebeling & Pence 1957, Ebeling & Forbes 1988), and even glass shards (Pallaske & Igarashi 1991) screened to specific particle sizes have proven to be effective in preventing termite penetration, although the effective particle size ranges differ from one termite species to another (Su & Scheffrahn 1992).

Although sized particle barriers are useful tools for termite prevention, they can be difficult to install in some situations. Unstable or not fully compacted soil, rough or irregular surfaces at the edges of the particle barrier, and protection from contamination or mixing with adjacent soil, sand, etc., are issues that must be addressed. Recently, an alternative termite barrier consisting of a marine grade 316 stainless steel mesh was developed and patented in Australia as TERMI-MESH (TERMI-MESH Australia Pty. Ltd.). This mesh has an aperture size of 0.66 mm by 0.45 mm, which is well below the 1.2 mm aperture size found by Ewart *et al.* (1991) to prevent passage of foraging Formosan subterranean termites, *Coptoptermes formosanus* Shiraki. In laboratory and field trials, Lenz & Runko (1994) found that a variety of Australian termite species, including *Coptotermes acinaciformis* (Froggatt), were unable to penetrate this mesh, and it is currently used in building construction in Australia.

Based upon the results obtained in Australia, this steel mesh has been used experimentally in Hawaii, both in conjunction with basaltic particle barriers and as a sole method of excluding subterranean termites. We report here the results of a one-year field exposure of TERMI-MESH to Formosan subterranean termites at three field sites in Hawaii.

MATERIALS AND METHODS

Our experimental units were based upon those of Lenz & Runko (1994), who placed wood inside TERMI-MESH "pillows" made from a flat sheet of mesh folded over lengthwise and then folded at either end to contain the wood (Fig. 1A, 1B). We placed one end of a "tube" of mesh (a single sheet, rolled and sealed with a longitudinal lap fold) over a solid concrete block, approximately 9 cm wide by 19 cm long by 5.5 cm high, and sealed the mesh around the circumference of the lower edge of the block with a bonding cement supplied by the manufacturer (TERMI-MESH Australia Pty. Ltd.). Nine Douglas-fir (*Pseudotsuga menziesii* [Mirb.] Franco) boards, each 25 by 8.5 by 1.8 cm, were placed vertically within the mesh bag, with the ends resting on the concrete block. A short length of PVC pipe (ca. 10 cm) was inserted through a hole cut in the side of the mesh bag, capped on the outer end with a pipe cap and fastened on either the inside or outside of the mesh bag (both configurations were used) with a stainless steel clamp. The top of the bag was sealed with a double-fold. Representatives of the manufacturer and of their local distributor (TERMI-MESH Hawaii Inc.) assisted in building and sealing the test units and were present during each phase of the experiment.

Ten similar test units (mesh bags containing wood) were constructed. Nine of these bags were placed individually in an upright position (with the concrete block on the bottom) within *C. formosanus* aggregation traps at field sites on the island of Oahu, Hawaii (Fig. 1C). These traps were originally described by Tamashiro *et al.* (1973) as a means of collecting termites and have been used extensively in field evaluations of the termite resistance of various cellulosic materials. Each termite trap consists of an 18.9 liter (5 gallon) metal can placed on the soil surface, with the bottom removed and the top covered by a sheet metal lid, at a field site on the island of Oahu, Hawaii. Since termites were actively feeding upon Douglas-fir lumber within each trap at the time the steel mesh test units were placed in the field, this represents a rigorous termite exposure.

Three of the ten test units were placed within traps located at a field site on the Manoa campus of the University of Hawaii, three were placed in traps at a second field site on the Manoa campus, and three were placed in traps at a field site at the Poamoho Research Station near Wahiawa in central Oahu. In each case, short lengths of Douglas-fir lumber were packed around the mesh bag within the trap to ensure a high degree of termite activity and pressure on each test unit. In addition, a shallow hole was excavated at the Poamoho field site adjacent to the active termite traps, and the tenth and final test unit was buried, surrounded by short lengths of Douglas-fir lumber as in the above-ground trap placements (Fig. 1D).

The nine test units placed in the above-ground termite traps were observed monthly, and the surrounding bait wood replaced as necessary to ensure continuing high termite pressure around each mesh bag. Termites were active in all nine traps at the three field sites throughout the one-year test, with extensive carton construction visible on the exterior upper portion of each mesh bag. The buried test unit was not disturbed until the conclusion of the test.

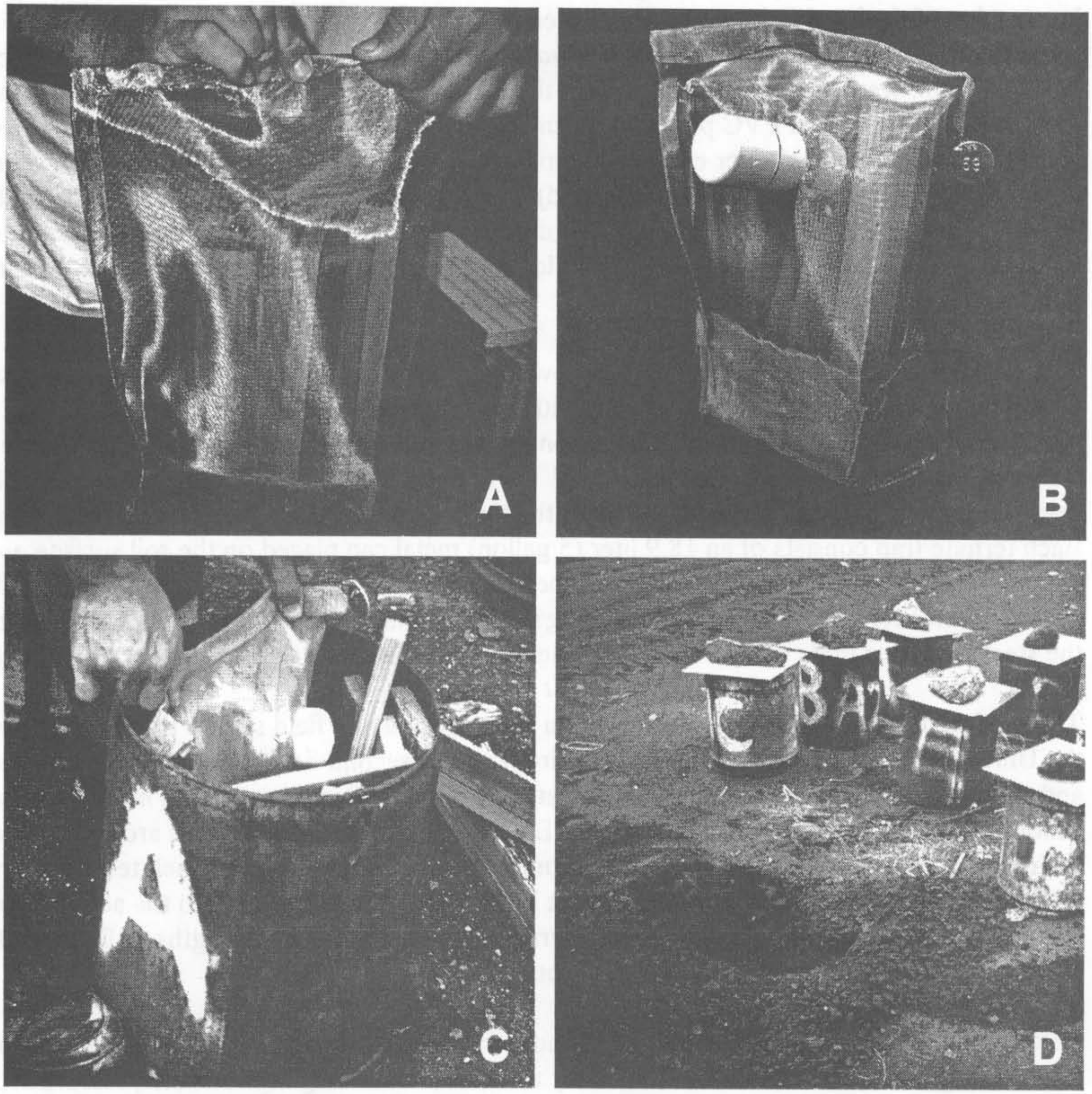

Figure 1. Preparation of the steel mesh test units (A and B), and placement with bait wood in a termite trap on the soil surface (C) and in an excavation at a termite field site (D).

The test units were placed in the field in March 1995, and removed for evaluation one year later in March 1996. Active termites were noted in the wood surrounding each mesh bag in the above-ground traps, and the bait wood surrounding the buried bag had been completely destroyed by termite feeding. The exterior of all ten bags evidenced extensive carton construction, and termites had clearly explored the entire exterior surface of each bag. The exterior and interior of each bag, and the wood within, were carefully examined for any evidence of termite penetration of the test units.

RESULTS AND DISCUSSION

Formosan subterranean termites did not penetrate the steel mesh directly in any of the ten test units. As mentioned above, the mesh size is below that found by Ewart *et al.* (1991) to exclude *C. formosanus* foragers. Further, the mesh showed no evidence of any rupture or degradation resulting from the test conditions, the relatively warm and humid local environment, nor the concentrated termite activity on the exterior of each test unit. The plastic pipes remained firmly clamped in position. Without regard to whether the pipe clamps were installed on the interior or exterior of the mesh bag, there was no evidence of any termite penetration around nor through these pipes. Thus, we conclude, as did Lenz & Runko (1994) with respect to Australian termite species, that TERMI-MESH is an effective barrier to *C. formosanus*.

The potential problem areas in installation of any termite-resistant building material or physical barrier are the edges: the points at which that material abuts or joins other construction materials. Termites did not penetrate any of our test units through the steel mesh directly, through the folds sealing the top of the mesh bag, nor around the pipe clamps. However, in one of the nine above-ground test units, the bonding cement used to seal the steel mesh to the corner of the concrete block failed to hold the thick longitudinal fold in the mesh in place. Thus, in that single test unit, termites were able to enter through a fine crack in the bonding cement at the lower edge of the concrete block (Fig. 2). It is important to note that this particular type of joint, in which a heavy fold of the steel mesh is bonded flush to a 90° concrete corner, should not occur (or at least represent a very unusual occurrence) under the conditions in which TERMI-MESH is normally installed in building construction. The edge of the mesh is normally either imbedded in concrete, or sealed with bonding cement to a flat surface. Therefore, we consider this penetration to be more representative of a failure of the test design to accurately replicate construction detail than a failure of the TERMI-MESH installation method. However, we are currently conducting a second field test in which folds in the mesh have been bonded to flat concrete surfaces away from masonry corners to more accurately mimic construction detail and investigate whether improvements in installation methods are warranted.

Although our results demonstrate that TERMI-MESH is an effective barrier to *C. formosanus*, they also clearly demonstrate that care must be taken in installing this and any other physical barrier to ensure that termites cannot circumvent the edges of the barrier. Careful building design (including provision for future inspection access to critical areas), physical barriers, preservative-treated or naturally-resistant building materials, soil insecticides, and baits are not exclusive and

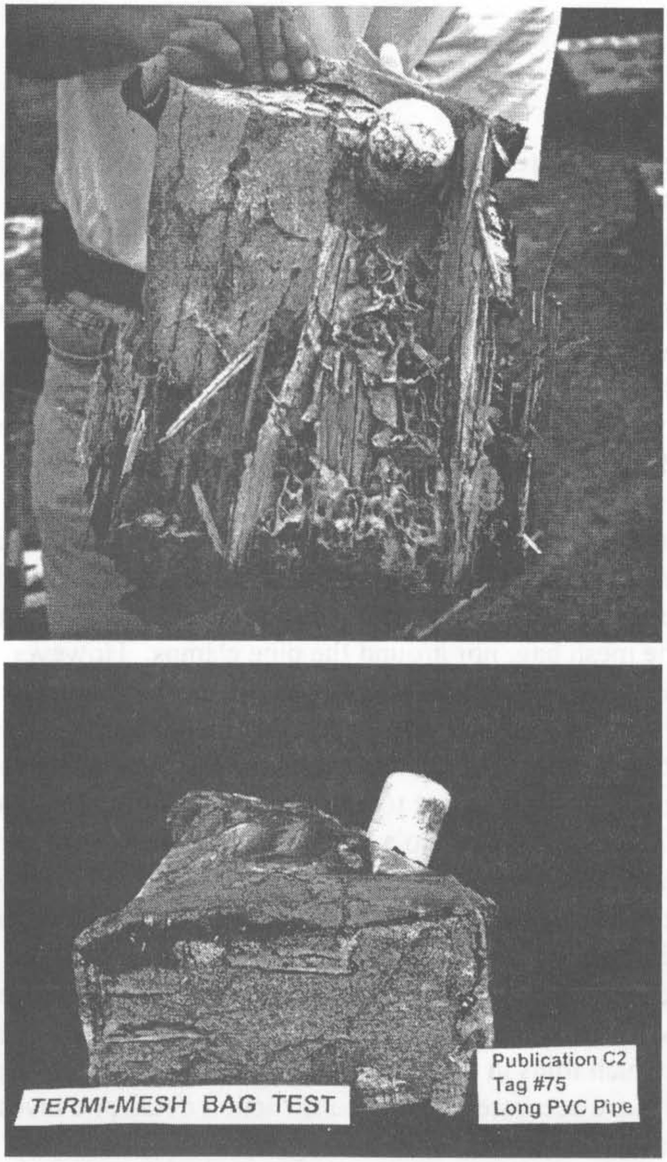

Figure 2. Test units removed after one year in the field (top) showed evidence of high termite activity on the exterior of the steel mesh. Termites did not directly penetrate the mesh in any of the ten test units. Bonding cement, however, failed to secure a heavy fold in the mesh at the corner of one test unit (bottom), allowing termite entry and indicating that careful installation is necessary to prevent termites from circumventing physical barriers.

incompatible methods of subterranean termite control. Physical barriers can be a valuable part of a multi-tactic approach to termite prevention.

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