MOVEMENT OF TERMITICIDE FOAM FOLLOWING APPLICATION WITH THE SLABJET 2000

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Summary: **The lateral movement of aqueous foam in a subslab void was measured following application with a Slabjet 2000, (B&G Equipment Co.). Permethrin termiticide (1% AI) foam was delivered to a 1-inch void below a sheet of plexiglass. The underlying substrates were fine sand, bare soil (clay), and gravel. Termiticide was applied at the rates of approximately 0.8 and 1.6 gallons, and at a nozzle pressure of 25 and 50 psi. After 24 hours samples of the top 1 inch of substrate were taken at sites 4, 8, 12, 16, and 18 inches on both sides and linear to the treatment hole (total of 10 sites). Results show the application of 1.6 gallons of liquid at 25 psi provided a continuous band of insecticide-treated sand and bare soil 18 inches from the treatment hole. The application of 1.6 gallons of liquid at 50 psi provided a continuous band of insecticide-treated soil beneath a layer of gravel 18 inches from the treatment hole. For the sand and bare soil substrates the concentrations of termiticide detected up to 12 inches from the application hose where suitable for subterranean termite control. These data show that hole spacing for applying termiticide to voids beneath concrete slabs using the Slabjet 2000 may be extended to 36 inches when the underlying substrate is bare soil and has a relatively even and uniform grade.**

Introduction: **Chemical control or prevention of subterranean termites includes the application of insecticides to the soil around the outside and to the soil under the foundation of the structure. The objective is to create a continuous and uniform band of termiticide-treated soil that will kill or repel foraging termites. The conventional methods for applying termiticides beneath foundation floors is low-pressure spraying of a liquid or a foam into the void (Thomas et al., 1993). The use of foam to deliver tremiticides to subslab voids has increased with the availability of foaming agents, foam-making machines, and special application tools such as the Slabjet 2000.**

Although there is data on the movement of liquid beneath concrete foundations (Hedges, 1989; Brehm, 1991; Thomas and Robinson, 1994), there is limited data on the movement of foam and the resulting residuals in subslab soil. Thomas and Robinson (1991, 1994) reported that foam spread 8 to 12 inches from the treatment hose to provide continuous coverage in gravel and soil substrates beneath concrete slabs. Thoms et al. (1993) reported that termiticide foam provided greater horizontal coverage than liquid applied beneath simulated slabs.

The objective of the research presented here was to determine the movement of a

termiticide foam generated with the Slabjet 2000 treatment tool. The effective movement of the foam was determined by measuring the residual concentration of permethrin in the top 1 inch of soil at 4, 8, 12, 16, and 18 inches linear from the treatment site. Variables include application rates of approximately 0.8 and 1.6 gallons, using 25 and 50 psi, and underlying substrates of sand, soil, and gravel.

Materials and Methods **The plexiglass plates (4 x 4 feet) were placed over a 3 inch layer of limestone gravel (#4 grade), and on 3 inches of naturally compacted sand, and on bare soil. The soil composition was 28% sand, 56% silt, 14% clay, 2% organic matter, and 17% moisture. Wood frames around the plates simulated foundation walls of a house. Termiticide foam was created using the Slabjet 2000 (B&G Equipment Co.) with a direction tip nozzle, and using 1% (AI) permethrin.**

Foam was applied to the top of the gravel, sand, and bare soil at the rate of approximately 0.8 (26 to 30 seconds of application time) and 1.6 gallons (58 to 62 seconds of application time) at 25 psi. The application rate to the gravel was 1.6 gallons (55 to 60 seconds of application time) at 50 psi.

Sampling and residue analysis. Samples of the top 1 inch of soil were taken from locations 4, 8, 12 16, and 18 inches on both sides and linear to the treatment hole. Five grams of soil was mixed with 5 grams of Ottawa sand and 10 grams of anhydrous sodium sulfate and let stand for 3 min. This mixture was then placed in a 250 ml bulb column with a glasswool plug. Two separate amounts of 50 ml of 1:1 acetone and hexane were added to the column and drained into a beaker at the rate of 3 ml/min. The total extracted liquid was reduced to 20 ml and placed in a 125 ml separatory funnel. After adding 60 ml of distilled water and 5 ml of a saturated solution of sodium sulfate, the mixture was shaken vigorously for 2 minutes, then set for 10 minutes to allow formation of water and hexane layers which were then drained into separate beakers. The water layer was returned to the separatory funnel and 8 ml of 15% methylene chloride was added. This mixture was vigorously agitated for 2 minutes and set undisturbed for 10 minutes. The water layer was discarded, and the hexane layer was added tot he hexane layer from the previous separation, along with 20 ml of distilled water. This mixture was gently agitated for 30 seconds and allowed to set for 10 minutes. The water layer was discarded, the hexane layer was drained through a column in anhydrous sodium sulfate into a beaker and evaporated to near dryness. Hexane rinses of the beaker were added to obtain the finished sample for analysis.

Permethrin in the soil samples was analyzed by gas chromatography (Trecor 540, Trecor Instruments, Austin, TX), using electron capture detectors and NI63 as an ionization source, and nitrogen as the carrier gas. Operating conditions were: oven temperature 240 C, injector temperature 245 C, and detector temperature 350 C. The column (18.2 m) was packed with 1.5% OV-17, 1.9% OV-210 on 100-120 Chromosorb WHP. Mean (± SEM) retention time for permethrin standards was 4.75 ± 0.01 min and 5.08 ± 0.02 min for the cis and trans isomers. Peak areas were determined with an integrator (Hewlett-Packard Model 3394A, Avondale, PA). Method sensitivity based on sample weight and volume permitted detection of 0.4 ng permethrin /mg soil. The mean (± SEM) recovery rate of 88% ± 15%, was determined by analysis of soil samples to which 2 ug of permethrin had been applied. Parts per million (ppm) were calculated using ug of permethrin/dry soil weight.

Results **The application of foam using the Slabjet 2000 resulted in horizontal distribution of the termiticide beneath the simulated slab (Table 1). A continuous band of insecticide-treated soil extended 18 inches from the treatment hole on the sand and bare soil substrate when the application rate was 1.6 gallons. The slightly uneven distribution of the termiticide residue is probably the result of an irregular soil and sand surface, which may occur naturally in field situations. There was significantly less horizontal distribution of the termiticide on the soil and sand substrate with the application of 0.8 gallons.**

The horizontal distribution in the gravel substrate was about 12 inches with the application of 1.6 gallons, and 8 inches with 0.8 gallons. Gravel presents both a physical and surface area obstacle for liquid and foam movement. The pieces of gravel restrict the horizontal flow of the foam, and the size of the gravel pieces affects the amount of termiticide that is delivered to the soil substrate because some of the liquid draining from the foam is retained on the gravel surface. Some of the factors that restricted the horizontal flow in gravel were overcome with the use of 50 psi and applying 1.5 gallons. The uneven distribution of the termiticide may be the result of a slight pitch to the soil underlying the gravel.

Discussion: **Effective residue. Application of termiticide foam with the Slabjet 2000 resulted in an effective barrier to subterranean termites in the top 1 inch of soil and sand substrates from 4 to 12 inches using 0.8 gallons, and to 18 inches using 1.6 gallons. An effective barrier was created in the soil below the gravel at 8 inches using 0.8 and 1.6 gallons, and at 18 inches using 1.6 gallons and 50 psi. su and Scheffrahn (1990) reported that a termiticidal activity is linked to the quantity of insecticide in the soil. They report that 0.8 to 1.1 ppm of permethrin in soil prevented subterranean termites from penetrating treated soil. In the results presented here the mean ppm of permethrin detected at sample sites 4 to 18 inches (application rate of 1.6 gallons) for the sand and bare soil exceeded the residue thresholds suggested by Su and Scheffrahn (1990). The residue thresholds were met with the gravel at 18 inches following application of 1.6 gallons at 50 psi..**

Table 1. Mean ug (ppm) of permethrin in 5 grams of the top 1 inch of soil 24 hours after application of a foam beneath a 4x4 ft. plexiglass sheet, using one treatment hole and five sampling sites lateral to the hole.

X ppm permethrin

Substrate Application Sampling distance (in.) from treatment hole

Substrate	Application Rate (gal.)	18	16	12	8	4
Sand	0.8	---	---	19.5	99.2	85.1

	1.6	39.4	157.4	159.9	199.8	190.3
Soil	0.8	---	--	329.0	820.3	1510.3
	1.6	141.2	296.6	542.1	821.0	935.6
Gravel	0.8	---	---	0.3	460.0	923.5
	1.6	---	---	0.9	806.9	935.3
(50 psi)	1.6	66.5	211.7	149.6	724.7	1831.5

Distribution: The expected result of the use of foam to deliver the termiticide was an increase in the horizontal movement of the material, and this would be indicated by the residue in the substrates. Treatment with liquid requires the application of 0.4 gallons per linear foot to achieve the desired overlap at 6 inches between treatment holes, which are spaced 12 inches apart. This application rate and distance would also achieve a lethal concentration of termiticide at and between the treatment sites. For this study it was expected using the Slabjet 2000 would result in about twice the horizontal movement of the liquid, so the application rate was increased from 0.4 to 0.8 gallons at the treatment hole.

Bare soil. For the bare soil the foam delivered an effective dose (329 ppm) 12 inches from the treatment hole when applied at about 0.8 gallons per treatment hole. This would allow for treatment hole spacing to be increased from 12 to 24 inches, and still achieve a continuous band because of the overlap between two adjacent holes. By further increasing the application volume to 1.6 gallons the spread of effective quantities increased to 18 inches from the treatment hole. This would allow for treatment holes to be spaced 36 inches and still achieve a continuous band because of the potential overlap between adjacent treatment holes.

Sand. For sand the Slabjet 2000 delivered foam at an effective dose (19 ppm) 12 inches from the treatment hole when 0.8 gallons was used. Increasing the amount applied to 1.6 gallons increased the spread to 18 inches. As with the treatments on bare soil, the movement of foam achieved with the Slabjet 2000 would allow for increasing the distance between treatment holes in slab from the typical 12 inches to 24 inches (with 0.8 gallons applied per hole) to 36 inches (with 1.6 gallons applied per hole). The differences between the soil and the sand in the amounts of termiticide detected probably reflect the adsorption of some of the liquid to the surface of the sand particles.

Gravel. The gravel pieces were an impediment to the lateral movement of foam, and to the amount of liquid delivered to the soil below. The gravel restricted the lateral movement of the foam, and retained some of the liquid on the surface so less reached the soil. At the application rates of 0.8 and 1.6 gallons the foam delivered an effective dose (460 and 806 ppm, respectively) only 8 inches from the treatment hole. This would permit applications to be made 16 inches apart, which is not significantly different than the currently used 12 inch separation. An application rate of 1.6 gallons at 50 psi was used to increase the movement of the foam in the gravel. The result was that an effective dose (66 ppm) was delivered 18 inches from the treatment hole. This would permit applications to sub slab voids containing gravel to be made 36 inches apart and still have sufficient overlap to create a continuous barrier of treated soil.

References

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