Method to Monitor Initiation of Aerial Infestations by Alates of the Formosan Subterranean Termite (Isoptera: Rhinotermitidae) in High-Rise Buildings

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ABSTRACT Wood devices were placed on roof surfaces of multi-storied buildings to monitor establishment of aerial infestations by alates of the Formosan subterranean termite, *Coptotermes formosanus* Shiraki, in urban southeastern Florida during one swarming season. A total of 80 alate visits was recorded from 20 devices, with nine pairs successfully establishing copulatoria.

KEY WORDS Insecta, above-ground colonies, *Coptotermes formosanus*, copulatorium

AERIAL INFESTATIONS of subterranean termites are defined as structural infestations with no connection to the ground. The Formosan subterranean termite, *Coptotermes formosanus* Shiraki, is known to establish aerial colonies that may require nest removal or structural fumigation for control. Aerial infestations account for approximately 25% of structural infestations by *C. formosanus* in urban southeastern Florida (Su & Scheffrahn 1987a), and more than 50% of high-rises in Waikiki, Honolulu, Hawaii (Tamashiro et al. 1987).

There are three types of aerial infestations; those started by alates, subterranean colonies moving to aboveground sites, and part of a colony separated from the ground surviving with an aerial moisture source (Tamashiro et al. 1987). Although it is speculated that *C. formosanus* alates are swept upward by wind currents to start aerial infestations on the top of high-rises (Tamashiro et al. 1987), the frequency of successful alightment and copulatorium formation by alate pairs has not been documented.

We describe herein a device that was placed on the roofs of high-rise buildings to monitor initiation of aerial infestations by *C. formosanus* alates in urban southeastern Florida during the swarming season of 1986.

Materials and Methods

An alate entrapment device shown in Fig. 1 is a pine (*Pinus* sp.) board (3.8 by 8.5 by 120 cm) in which 31 cylindrical cells (13 mm diameter by 10 mm deep) are drilled 37.5 mm apart. A groove (3.5 mm wide and 5 mm deep) is sawn through the center of each cell across the width of the board. A wood cover (1.0 by 8.5 by 120 cm) is attached to the board by two metal hinges and fastened by two hook-and-eyelet closures. When covered, the grooves provide alates with pathways leading to each cell. Before fastening, a plate of clear epoxy glass (2.5 mm by 8.5 cm by 120 cm) is sandwiched between the board and the cover. When the cover is lifted for observation, the epoxy glass prevents escape of alates. The board is soaked in water for 24 h before use.

Thirty units were constructed. Ten each were placed on the rooftops (flat roofs) of a 14- (site I) and a 4-storied building (site II), and on the ground level of site I. Both buildings are located in Hallandale, Fla. The 14-storied building (approximately 42 m tall) was fumigated previously for a *C. formosanus* aerial infestation. No termite activity was found in the structure during our experiment. No structural infestation was found in the 4-storied building (approximately 12 m tall), but active ground colonies of *C. formosanus* had been monitored in the vicinity of both sites using the trapping system of Su & Scheffrahn (1986).

Observations were made at 7–10-d intervals from May to July 1986 when *C. formosanus* alates were swarming. Numbers of single alates visiting the units, mated alate pairs, and other insects found in the cells were recorded and removed. Two pairs of *C. formosanus* wings (fore and hind wings) were typically found together in one cell and constituted one alate visit. When a dealated swarmer (dead or alive) was present in the same unit, however, the wing set was considered to originate from that individual and was not scored as a visit. Mated pairs were counted as two visits. Ambient, roof surface, and cell temperatures were measured using a digital thermometer (Model 8110-30, Cole-Parmer Instrument Company, Chicago, Ill.).

Results and Discussion

A total of 68 and 12 *C. formosanus* alates visited site I and II, respectively. The alate catch peaked

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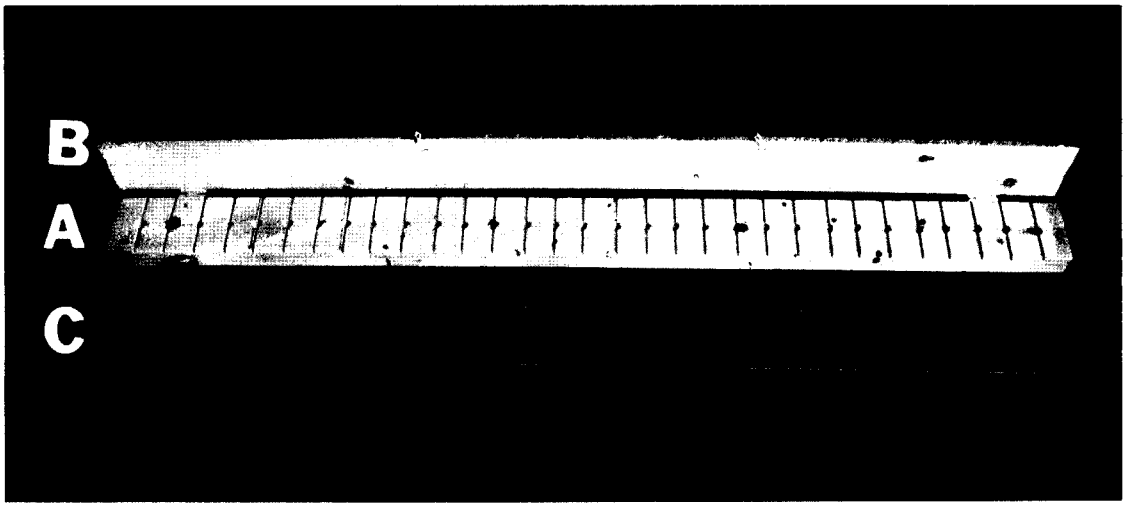

Fig. 1. A wood device for monitoring initiation of aerial infestations by alates of the Formosan subterranean termite. A, wood board with 31 cylindrical cells; B, wood cover; C, clear epoxy glass.

in June as shown in Fig. 2. This coincides with mating flight patterns of this species in southern Florida (N.-Y.S. & R.H.S., unpublished data). Nine pairs of *C. formosanus* successfully established in cells of those units placed on the roof at site I (Fig. 3). The mated pairs typically plugged both ends of the groove path with masticated wood. Approximately 20–50 eggs were found in the paired-alate cells. No mated pairs were found at site II. Units on ground level yielded no insect catch. On ground level, there were probably more suitable locations for initiation of copulatoria than the provided devices. No structural infestation was present in either building, so alates found on the rooftops originated from ground colonies, or aerial colonies in nearby buildings.

In addition to *C. formosanus* alates, seven alates of *Cryptotermes* spp., nine *Incisitermes* spp., one *Reticulitermes* sp., and 11 ants of unidentified species were observed in the cells of both sites. Two established pairs of drywood termites (*Cryptotermes* spp.) also were found in the cells.

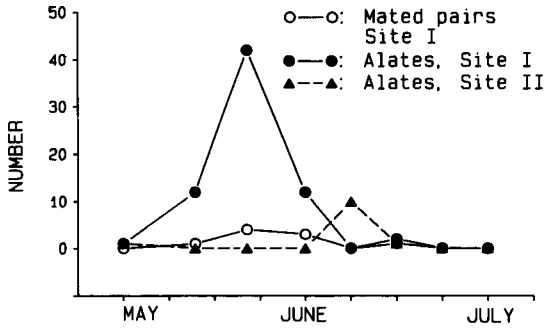

Fig. 2. Numbers of *C. formosanus* alate visits (solid circles and triangles) and mated pairs (open circle) recorded from roofs of two multi-storied buildings during the 1986 swarming season in Hallandale, Fla. No mated pairs were found from site II.

During our survey period, the ambient temperature at about 1000 hours (EST) was approximately 35°C, but the roof surface and cell temperatures exceeded 45°C. These high temperatures are unsuitable for termite survival (French & Johnston 1968, Rust et al. 1988). We suspect that more alates than counted visited our units but that high temperatures forced them to depart before each weekly observation. More catches may have resulted if earlier daily counts had been made.

Flat roofs of high-rises accumulate water, from rainfall and water condensation of air-conditioning units. Moreover, wood-particle boards are commonly used for roof insulation in many buildings. Crevices that have developed in roof surfaces lead alates to the moistened wood insulation to conceive aerial infestations. Roof surface temperatures are high during daytime. Because *C. formosanus* swarms at night, alates might locate sites with lower temperatures deeper inside the building before the temperature rises.

A single colony of *C. formosanus* can produce >68,000 alates (Su & Scheffrahn 1987b). A portion of these may be carried by wind currents to land on the rooftops of high-rise buildings. Our results showed that at least nine pairs of *C. formosanus* alates established copulatoria during one swarming season. Extensive infestations will result from a single reproductive pair within 3–5 yr. Elimination of an aerial infestation often requires fumigation of the entire building. Expenses for fumigating one multi-storied building, including cost for chemicals, labor, evacuation of residents, and miscellaneous expenses, range between $10 and $100 thou-

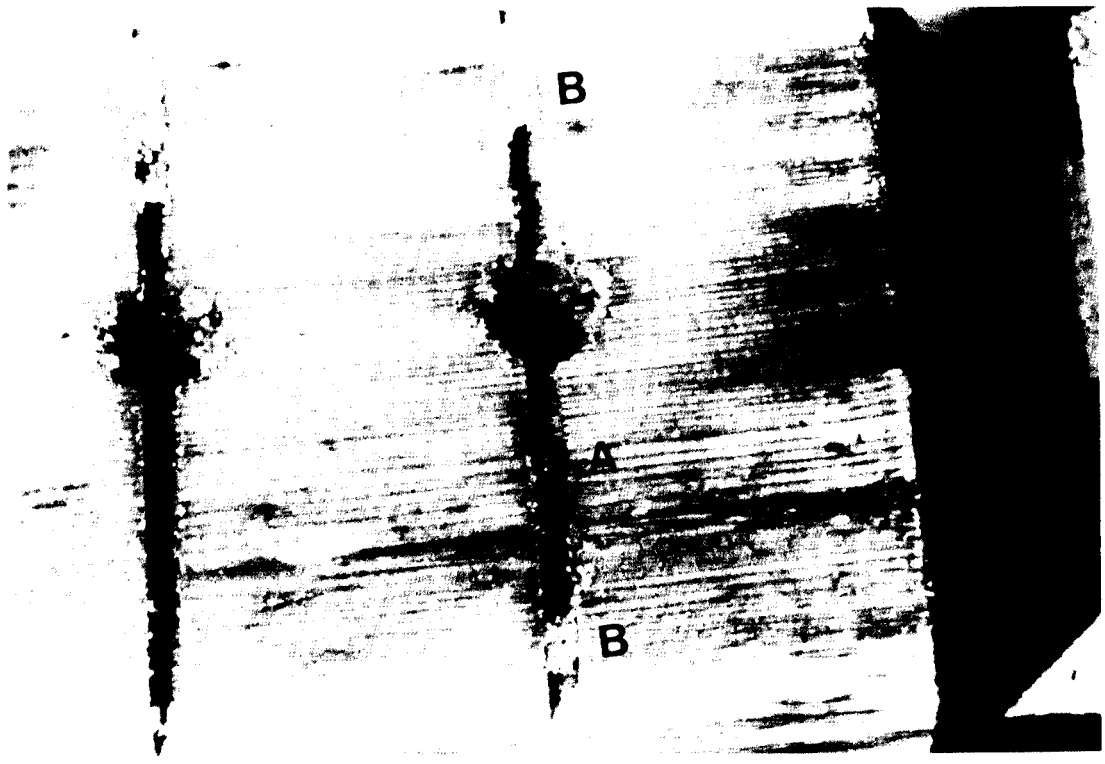

Fig. 3. A mated pair of *C. formosanus* alates established in a cell of the monitoring device. A, alate; B, plugged groove path.

sand in urban southeastern Florida. Proper fumigation effectively eliminates aerial colonies, but leaves no residual protection. Reinfestations by alates have been one of the serious problems for control of *C. formosanus*.

The device described here can be used to detect the potential of aerial infestations and to study biology of aerial colonies. When alates are caught in the devices, the areas are considered infested by *C. formosanus*. Before the swarming season of the following year, residents and pest control firms are advised to spray crevices (cracking, under roof flashings, etc.) on flat roofs with residual insecticides (chlorpyrifos, etc.) (Su & Scheffrahn 1985).

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