

A Shallow Sub-surface Monitoring Station for Subterranean Termites (Isoptera)

by

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ABSTRACT

A monitoring station consisting of a flat plastic container with numerous holes on the sides and a cut-out bottom was installed near the soil surface for monitoring subterranean termites. Termite foraging tunnels in the soil were quickly reconstructed and extended to the wood block in the station through the holes on the side of the station. The new shallow design was more attractive to the eastern subterranean termite, *Reticulitermes flavipes* (Kollar), than the previous version of the underground monitoring station in which foraging tunnels may be hindered by its solid plastic collar.

INTRODUCTION

Monitoring devices placed on ground surface have been used to study foraging activities of subterranean termites (La Fage *et al.* 1973, Tamashiro *et al.* 1973). Su & Scheffrahn (1986) developed an underground version of the device described by Tamashiro *et al.* (1973) for monitoring populations of the Formosan subterranean termite, *Coptotermes formosanus* Shiraki, in urban southeastern Florida. The underground station was further modified by Grace (1989) for studying *Reticulitermes* spp. in Ontario, Canada.

The underground monitoring stations are designed to be well hidden to avoid attention and possible vandalism in populated urban areas (Su & Scheffrahn 1986). This device has been used to estimate foraging population size, and foraging territories of *C. formosanus* (Su & Scheffrahn 1988) and the eastern subterranean termite, *Reticulitermes flavipes* (Kollar) (Grace *et al.* 1989, Su *et al.* 1993). Moreover, these monitoring stations were instrumental for evaluating the efficacy of bait applications against field colonies of subterranean termites (Su *et al.* 1991, Su, in press).

Stake surveys were typically done prior to the installation of underground monitoring stations. Infested stakes were replaced by stations that included wooden blocks surrounded by a plastic collar measuring

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17cm O.D. by 15cm high (Su & Scheffrahn 1986). Because soil surrounding the infested stake had to be removed for placement of the plastic collar, the disruption sometimes caused termites to avoid the wooden block in the station. Removing rocky or hard, dry soil to form a hole measuring 17cm outside diameter and 15cm deep is often difficult, and causes more disturbance to foraging termites in the vicinity. Moreover, termites that tend to forage near soil surface (especially those found in soil covered with leaf litter) may not intersect with the wooden block because their foraging paths are blocked by the solid plastic collar extending 15cm in depth from the soil surface.

In this study, we describe an underground monitoring station for studying the populations of subterranean termites that forage near the soil surface and/or in rocky, hard soil.

MATERIALS AND METHODS

A shallow sub-surface monitoring station was composed of a flat plastic container (14cm by 20cm by 5cm deep) with a snap-on cover (Fig. 1). The container bottom was cut out, leaving only one half-circle tab (3cm diameter) at the center edge of the cutout, and two quarter-circle tabs at its opposing two corners. A 1-cm-diameter hole was drilled into each tab to accommodate anchor nails. Each of the 5-cm-wide sides of the station were drilled with three rows of 3-mm-diameter holes to provide broad access for termites.

Following the procedure for monitoring stations described by Su & Scheffrahn (1986), a stake survey was first done to detect the presence of termite activity in soil over a broad area (Fig. 2a). Soil surrounding an infested stake was excavated (Fig. 2b), and the monitoring station was anchored in the hole by driving three nails (12cm long) through the holes in the tabs (Fig. 2c) after the infested stake was removed. A wooden (*Picea* sp.) block made of five wooden boards (two boards measuring 17.5cm by 6cm by 1.9cm thick at the bottom, and three boards measuring 14cm by 6cm by 1.9cm thick on the top) nailed together was placed in the station (Fig. 1). The cover was snapped on and a thin layer of soil was used to cover the station. Although some foraging tunnels were probably blocked when soil was excavated, termites in the foraging tunnels had access to the station through holes on the side and commenced feeding on the wooden blocks (Fig. 2c).

A total of 25 and 23 shallow monitoring stations were installed between March and August 1993, for 11 *C. formosanus* colonies, and 8 *R. flavipes* colonies, respectively. During the same period, 65 and 59 monitoring stations similar to that of Su & Scheffrahn (1986) (referred to as deep stations) were installed for these colonies of *C. formosanus*

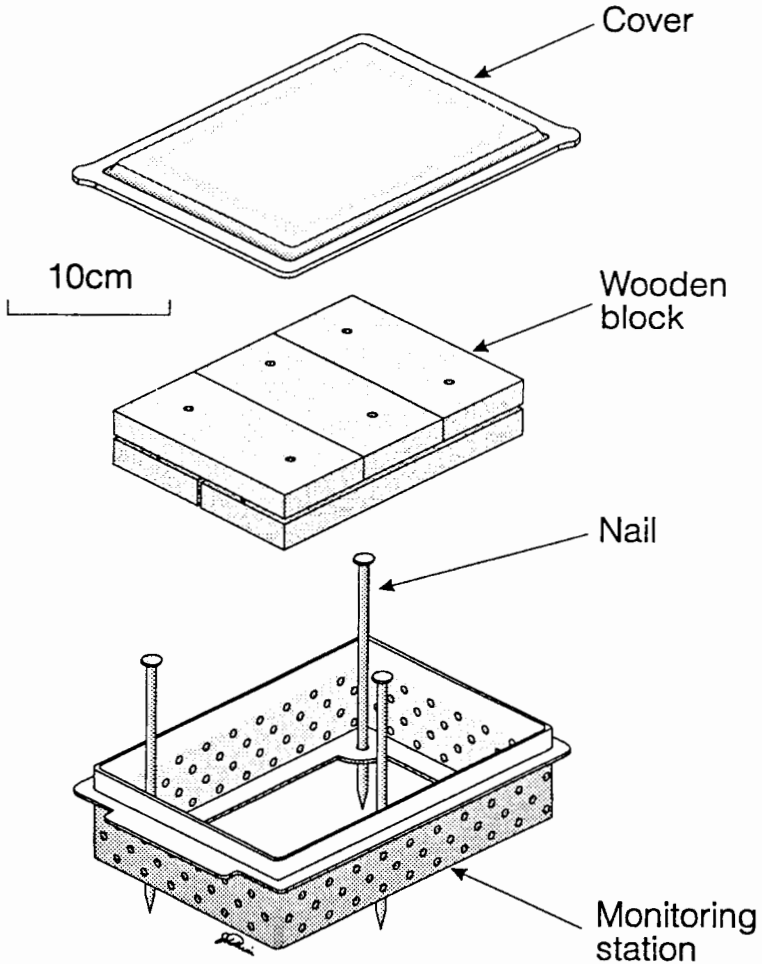


Fig. 1. A shallow sub-surface monitoring station consisting of a modified plastic box containing a wood block.

and *R. flavipes*, respectively. Wood blocks were dried at 80°C for 48h and weighed (± 0.1 g) before placement in monitoring stations. Despite their different configurations, initial dry weights of wooden blocks used for shallow stations (372.9 ± 27.3 g) were similar to those used for the deep stations (381.0 ± 23.1 g) (based on 20 randomly selected blocks each).

Monitoring stations were checked monthly for the presence of termite activity. Blocks with termite activity, replaced with new blocks, were brought back to the laboratory. Termites in the blocks were separated

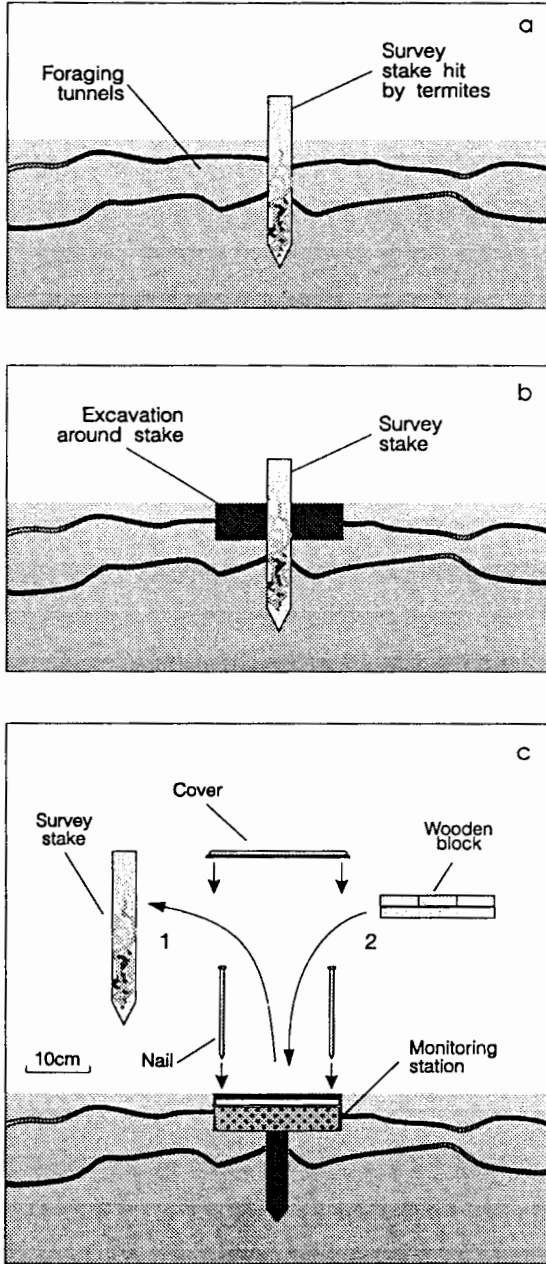


Fig. 2. Soil surrounding an infested survey stake (a) is removed (b), and a monitoring station is anchored in the hole (c). A wooden block is placed in the station after removing the infested stake (c). The cover is snapped on and a thin layer of soil is placed over the station.

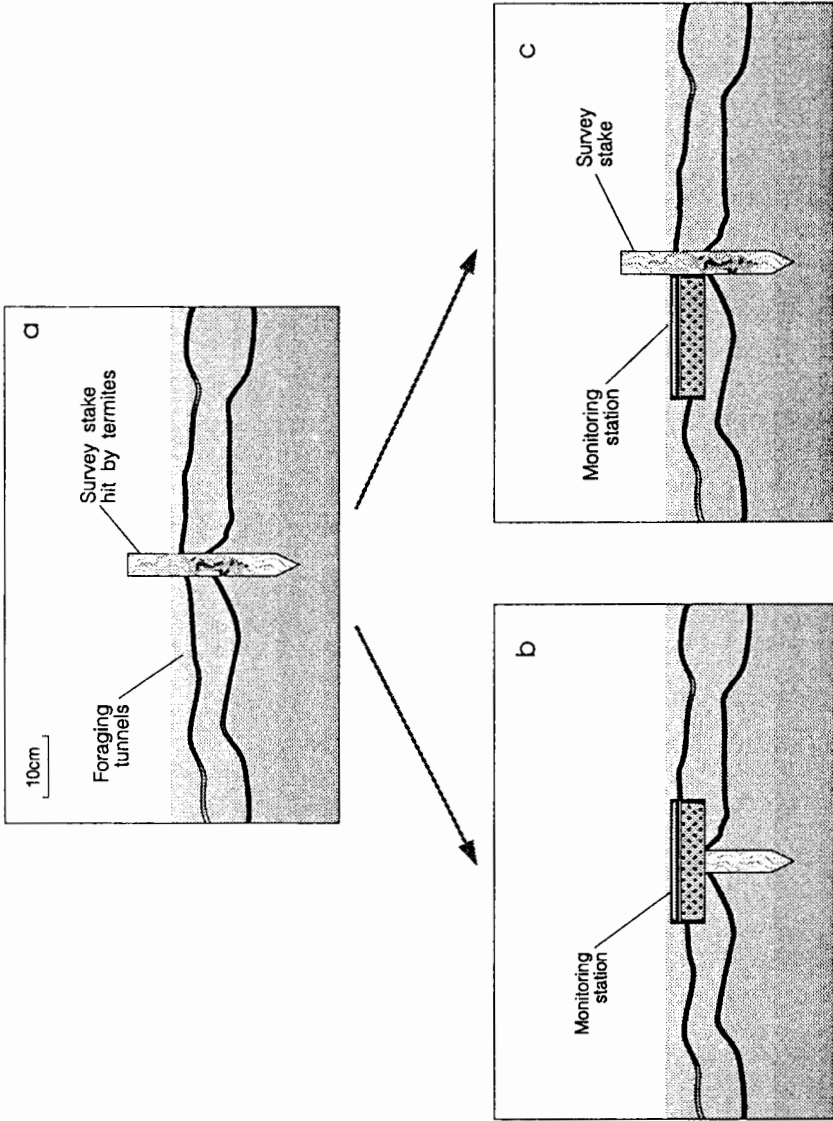


Fig. 3. Alternatively, a short stake is inserted into the remaining hole previously occupied by the infested stake (a and b), or soil adjacent to the infested stake is excavated for placement of the station (c), thus leaving the infested stake and most of the foraging tunnels undisturbed.

from debris using the method of Tamashiro *et al.* (1973), counted, and returned to the stations from which they were collected. Wood block remnants were rinsed under running water, oven-dried, and weighed as above. Difference in the number of termites collected, wood weight loss (g/station), and wood consumption rate (g/station/day) between shallow and deep stations were compared using a *t*-test for each termite species (SAS Institute 1985).

RESULTS AND DISCUSSION

Of the 25 shallow stations installed for *C. formosanus*, three (12%) were abandoned by the termites during the 6-month observation period. Whereas, only one of the 23 stations (4%) was inactive with *R. flavipes* during the same period. The success rate for termite establishment in the deep monitoring stations was similar for *C. formosanus* (7 out of 65, or 11% inactive) and *R. flavipes* (6 of 59, or 10% inactive). For *C. formosanus*, no differences in wood weight loss or wood consumption rate were observed between shallow and deep stations at the $P < 0.05$ level (Table 1). Slightly more *C. formosanus* were collected from deep than shallow stations. Significantly more *R. flavipes* were collected from shallow stations than deep stations (Table 1). Foraging by *R. flavipes* was also more intensive in shallow than deep stations, as shown in wood weight loss and wood consumption rate (Table 1).

The station design probably would not affect foraging activity of aggressive species such as *C. formosanus*. Even though foraging paths were blocked during the installation of deep stations, *C. formosanus* eventually entered the stations because of their aggressive foraging in soil. *R. flavipes*, however, can be easily discouraged from foraging in the monitoring stations when their foraging tunnels are disrupted. The 3 rows of 3-mm-diameter holes drilled on the sides of the shallow station probably aided *R. flavipes* to re-establish their foraging tunnels (Fig. 2c).

The shallow station design is for placement near the soil surface, thus enabling its installation in rocky or hard soil where a deep hole is difficult to excavate. The installation of a shallow station is much easier than a deep one even in the sandy soil of south Florida. Moreover, the shallow station is more suitable for subterranean termites that tend to forage near the soil surface.

Other procedures are also being tested to further enhance the effectiveness of the shallow design. For example, a smaller wooden stake was placed in the hole previously occupied by the original infested monitoring stake, thus encouraging termite foraging activity and providing termites with a guide into the station (Fig. 3b). For termite

Table 1. Mean numbers of termites collected, wood weight loss (g/station), and wood consumption rate (g/station/day) from shallow or deep monitoring stations.

Station	n ^a	No. termites	Wood Weight Loss (g/station)	Wood Consumption Rate (g/station/day)
<i>C. formosanus</i>				
Shallow	59	2,756 ± 403	116.4 ± 16.6	3.6 ± 0.5
Deep	245	3,750 ± 225	134.3 ± 7.6	4.6 ± 0.3
P ^b		0.0469	0.3077	0.0748
<i>R. flavipes</i>				
Shallow	85	3,683 ± 342.5	52.2 ± 8.1	1.4 ± 0.2
Deep	324	2,504 ± 196.0	32.7 ± 3.2	0.9 ± 0.1
P ^b		0.0065	0.0102	0.0245

^a Number of observations recorded from all of the stations between March and August 1993.

P^b < 0.05 indicates a significant difference between shallow and deep stations according to *t*-test.

species or colonies that tend to avoid even the shallow station, especially when the infested survey stake was removed, soil adjacent to the infested stake was excavated for placement of the station, thus leaving the infested stake and most of the foraging tunnels undisturbed (Fig. 3c).

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