

# INTERFACING BASIC BIOLOGY OF *RETICULITERMES* SPP. AND THE SENTRICON™ TERMITE COLONY ELIMINATION SYSTEM IN NORTHERN CALIFORNIA, USA

GAIL M. GETTY<sup>1</sup>, MICHAEL I. HAVERTY<sup>1</sup>, VERNARD R. LEWIS<sup>2</sup>,  
AND RONALD J. SBAGIA<sup>3</sup>

<sup>1</sup>Chemical Ecology of Forest Insects, Pacific Southwest Research Station, USDA Forest Service, P.O. Box 245, Berkeley, CA 94701 USA

<sup>2</sup>Division of Insect Biology, Department of Environmental Science, Policy, and Management,  
University of California, Berkeley, CA 94720 USA

<sup>3</sup>Dow AgroSciences, Professional Pest Management, P.O. Box 1671, Placerville, CA 95667 USA

**Abstract** - Using triple-mark-recapture and agonistic behavior studies one colony, consisting of 7 monitoring stations, was determined to consist of approximately 147,000 *Reticulitermes* foragers. This single colony was baited using Sentricon™ Termite Colony Elimination System. Sixty days later termites were absent from all monitoring and Sentricon™ stations and remained unoccupied for at least 18 months. Eighteen months later foraging *Reticulitermes* appeared in one of the monitoring stations; 6 months after that, another monitoring station was occupied by foraging *Reticulitermes*. Utilizing cuticular hydrocarbon analysis and agonistic behavior studies, we determined that the termites occupying these monitoring stations were from 2 different colonies; neither of them were members of the original colony eliminated by baiting.

**Key words** - Termite baiting, agonistic behavior, mark-recapture

## INTRODUCTION

Baits, using different active ingredients and bait matrices, are currently available and being developed by several manufacturers. The success of baits will depend on an understanding of the size of termite populations, the extent of their foraging territories, and their behavior associated with foraging. We used the Sentricon™ Termite Colony Elimination System to demonstrate whether suppression or elimination of colonies was achievable. First we developed an understanding of the ecology and behavior of *Reticulitermes* at a residential site, then we baited the colony, then we monitored the site for continued, renewed, or new termite foraging activity to assess the Sentricon™ Termite Colony Elimination System.

## METHODS AND MATERIALS

We utilized one residential site in Marin County north of San Francisco. This site has two single family dwellings on a one hectare lot. Twenty-six monitoring stations were used to observe the monthly foraging behavior of *Reticulitermes* (Lewis *et al.*, 1998). Cuticular hydrocarbons of the termites in every monitoring station were characterized monthly (Haverty and Nelson, 1997). Fourteen monitoring stations were occupied by phenotype A' and 12 by phenotype D.

Association of foraging groups of *Reticulitermes* in the various monitoring stations was determined by mark-release-recapture and agonistic behavior studies. Dispersion of colonies was tested by marking termites from one monitoring station by feeding them filter paper stained with 0.5% (wt/wt) Nile Blue A in the laboratory, then releasing them into their natal monitoring station. Using a triple-mark-recapture method marked termites were collected from various stations, thus determining those monitoring stations connected and used by a single colony (Grace, 1990; Su *et al.*, 1986; Forschler and Townsend 1996; Haverty *et al.*, 1999). Agonistic behavior between termites from all possible pairings of monitoring stations was observed in petri dish arenas in the laboratory. Paired groups of 10 workers from different monitoring stations (or the same monitoring stations as a control) were placed in petri dishes and behavior and numbers remaining alive at 24 h was observed (Haverty *et al.*, 1999).

If stained foragers moved from one station to another, then the monitoring stations were considered to be connected and utilized by the same colony. If termites from different monitoring stations demonstrated aggressive behavior toward one another, they were considered to be from different colonies. The combination of these two types of studies can be used to demonstrate, with reasonable certainty whether different groups of *Reticulitermes* in different monitoring stations are from the same or different colonies (Haverty *et al.*, 1999).

The termites collected monthly from each monitoring station were not returned to the collection station. Instead they were cultured in plastic boxes in the laboratory for future study. These cultures were later used to determine whether foragers appearing in monitoring stations vacated after baiting were from the original colony or from different colonies invading the former territory of the baited colony.

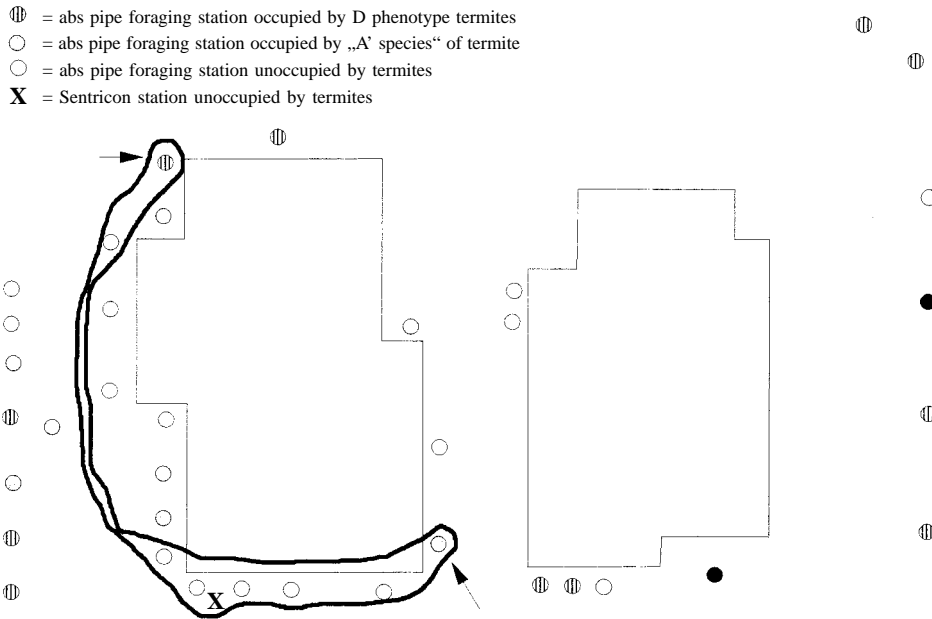
## RESULTS AND DISCUSSION

Results of our agonistic behavior studies support our assumption that different cuticular hydrocarbon phenotypes belong to different species. When termites of different phenotypes (A' or D) were placed together the results were unequivocal, fighting always occurred. When termites of different colonies of the same phenotype were placed together, immediate fighting was unusual but, after spending 24 hr together, mortality was almost always high (Haverty *et al.*, 1999).

In an attempt to define the foraging territory of one of several colonies we initiated a mark-release-recapture series on a single phenotype A' monitoring station in March 1996. Blue termites were released into one monitoring station (Figure 1). We discovered that the termites from this one monitoring station foraged on three sides of the structure, including 7 monitoring stations, and comprised a population estimated at 147,000 foragers. The distance between the furthest two stations within this colony was approximately 25 m (Haverty *et al.*, submitted). Stained termites were not only found in the 7 monitoring stations, but also in one Sentricon™ station. Agonistic behavior studies corroborated that all 7 monitoring stations and the single Sentricon™ station were all used by the same colony (Colony 1) of phenotype A' (Figure 1).



**Figure 1.** Sentricon and monitoring stations connected using triple-mark-recapture and agonistic behavior studies in Colony 1. Sentricon station baited in June 1996.



**Figure 2.** One station in January 1998 and one station in June 1998 in baited Colony 1 were occupied by termites. Using cuticular hydrocarbon analysis and agonistic behavior studies it was corroborated that these stations were occupied by two different colonies that had invaded this territory (stations denoted by arrows).

In June 1996 the Sentricon™ station in Colony 1 was baited with Recruit II™. During our monthly inspection in July 1996 all stations in Colony 1 showed signs of a suppressed colony. Although termites were present in all monitoring stations, including the Sentricon™ station, population numbers were approximately half that of the previous month. By August 1996 all monitoring stations in Colony 1 were devoid of foraging termites. This continued to be true until January 1998.

The monthly inspection in January 1998 yielded one station in Colony 1 to be occupied by termites (Figure 2). Using cuticular hydrocarbon analysis we determined that this station was occupied by the same phenotype A' termites. However, because termites were collected and maintained in the laboratory from each monitoring station, including those baited in Colony 1, agonistic behavior studies were then conducted pairing the newly discovered termites and termites from each of the cultures from monitoring stations previously occupied by the baited Colony 1. The newly discovered termites responded aggressively with the laboratory cultures of members of the former Colony 1. These studies corroborated that this station (Figure 2) was occupied by a different colony that had invaded this territory.

In June 1998 one monitoring station in baited Colony 1, at the farthest point away from the reinvaded station mentioned above, was found occupied by termites. Using cuticular hydrocarbon analysis, it was determined to be phenotype D, and therefore, a different colony than Colony 1 that was baited in June 1996.

In conclusion, we feel that this single colony, of approximately 147,000 foragers, has been successfully eliminated. In addition, we observed that the territory occupied by the eliminated colony can be invaded by other colonies over time. This observation emphasizes the need for continual monitoring of the structure and the termite-susceptible perimeter after successful elimination of one or more colonies of *Reticulitermes*. This is necessary to determine if re-invasion occurs, additional/supplemental baiting or other remedial measures can be undertaken.

## REFERENCES CITED

Forschler, B. T. and Townsend, M. L. 1996. Mark-release-recapture estimates of *Reticulitermes* spp. (Isoptera: Rhinotermitidae) colony foraging populations from Georgia, U.S. A. Environ. Entomol. 25: 952-962.

- Grace, J. K. 1990.** Mark-recapture studies with *Reticulitermes flavipes* (Isoptera: Rhinotermitidae) from Canada. *Sociobiology* 16: 297-303.
- Haverty, M. I., and L. J. Nelson. 1997.** Cuticular hydrocarbons of *Reticulitermes* (Isoptera: Rhinotermitidae) from California indicate undescribed species. *Comp. Biochem. Physiol.* 118B: 869-880.
- Haverty, M. I., K. A. Copren, G. M. Getty, and V. R. Lewis. 1999.** Agonistic behavior and cuticular hydrocarbon phenotypes of colonies of *Reticulitermes* (Isoptera: Rhinotermitidae) from northern California. *Ann. Entomol. Soc. Am.* (In press).
- Haverty, M. I., G. M. Getty, K. A. Copren, and V. R. Lewis. 2000.** Size and dispersion of colonies of *Reticulitermes* (Isoptera: Rhinotermitidae) in a wildland and residential location in northern California. *Environ. Entomol.* (Submitted).
- Lewis, V. R., M. I. Haverty, G. M. Getty, K. A. Copren, and C. Fouche. 1998.** Monitoring station for studying populations of *Reticulitermes* (Isoptera: Rhinotermitidae) in California. *Pan-Pacific Entomol.* 74:121-133.
- Su, N.-Y. and R. H. Scheffrahn. 1986.** A method to access, trap, and monitor field populations of the Formosan termite (Isoptera: Rhinotermitidae) in the urban environment. *Sociobiology* 12:299-304.