

# THE IMPACT OF IMIDACLOPRID ON SUBTERRANEAN TERMITE (*RETICULITERMES* SPP.) COLONIES LOCATED INSIDE AND AROUND RESIDENTIAL STRUCTURES

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**Abstract** This ongoing study in central North Carolina is making use of DNA technology (microsatellite genotyping) and long term monitoring to observe the immediate and prolonged effects of imidacloprid on subterranean termite colonies (*Reticulitermes* spp.) located inside and around residential structures. A set of 12 termite-infested houses in Raleigh, NC with active and accessible termites were selected for study and placed into a multi-year monitoring program. Termite infestations inside and around each house were extensively monitored and genotyped at 10 microsatellite loci to determine colony identity for a period of several months before treatment to develop a map of colony location and activity across each property. A licensed PMP applied imidacloprid as a liquid treatment (Premise<sup>®</sup> 75 WSP) at 0.05% by trenching and rodding around the outside of the foundation, and in some cases making limited interior applications. Initial results from the first four treated houses show that there can be numerous subterranean termite colonies (up to eight) in close proximity to structures and that attacks on a single house can originate from two different colonies simultaneously. The application of imidacloprid resulted in a rapid decline of termites inside each building with complete elimination of all known interior infestations within 7-85 d. Termite activity in the soil monitors placed along the foundation and in the yard of each property were also severely impacted following treatment with imidacloprid. In fact, all active monitors at each of these test sites became inactive at 21 - 80 d after treatment, even those located 17 - 50 ft. from the foundation wall. It was even observed that termite colonies detected in the outer ring of monitors, and distinct from colonies inside the structure, also disappeared following treatment. Long-term monitoring and genotyping over the next 2-3 yr will provide the best assessment of the effect of imidacloprid on the original termite colonies present at each site and the effect on new colonies that may try to recolonize the study area following application. The current status of results will be reported at this meeting.

**Key Words** Microsatellite markers, Premise<sup>®</sup>, efficacy, colony elimination

## INTRODUCTION

Evidence is accumulating to show that the active ingredient of Premise<sup>®</sup>, imidacloprid, is transferred between individual termites (Thorne and Breisch, 2001; Shelton and Grace, 2003; Tomalski and Vargo, 2004) and that effects can be far reaching beyond the treatment area (Osbrink and Lax, 2003). This study in central North Carolina makes use of microsatellite genotyping and long term monitoring to observe the immediate and long term effects of imidacloprid on subterranean termite, *Reticulitermes* spp., colonies located inside and around residential structures. DNA technology is particularly useful for "fingerprinting" colonies, providing a powerful means to distinguish workers belonging to different colonies and to delineate colony foraging areas (Husseneder et al., 2003; Vargo, 2003a, b; DeHeer and Vargo, 2004). A long term comparison of genotypes before and after treatment is being used to assess the impact of imidacloprid on the original termite colonies present at each site and the effect on new colonies that colonize the treated area after treatment.

## MATERIALS AND METHODS

Twelve termite-infested houses in Raleigh, NC have been placed into a multi-year monitoring program and were selected for study based on the presence of active and accessible termites inside each building. An extensive grid of soil monitors in the yard and wooden stakes under crawlspace houses was used to monitor termites at monthly intervals for at least 6 mo before treatment in order to develop a stable map of termite activity. Soil monitors consisted of sections of PVC pipe (5 x 12 cm) containing two wooden grooved bait blocks that were bound together with a nylon tie. Each soil monitor was capped with a 5 cm diameter PVC cap after sinking

fully into the soil. Soil monitors were placed about 1.5 ft. from the foundation all the way around the structure and another ring was placed further out in the yard from 12ft. to 75 ft. from the foundation wall. On average, there were 70 soil monitors installed around each structure, with a range of 54 to 89 (Table 1). Soil monitors were sampled monthly for a minimum period 6 mo before treatment in order to have an accurate map of termite colony location. Interior infestations consisting of active shelter tubes, and to a lesser extent damaged wood containing active galleries, were also sampled but on a less frequent basis in order to minimize disturbance to the termites inside the structure. Imidacloprid (Premise 75WSP) was applied at a concentration of 0.05% by a licensed PMP as follows: nine houses received a perimeter-only application by trenching and rodding around the outside of the foundation, four houses received a perimeter application coupled with limited interior treatment and one location received a full label application according to minimum regulations of the state of North Carolina.

Termite samples collected from each soil monitor and from inside each structure were identified to species using a PCR-RFLP method (Szalanski et al., 2003) and then genotyped at 10 microsatellite loci using established methods (Vargo, 2000; Dronnet et al., 2004). In addition, samples have been collected from “natural areas” in the yard of each house semiannually. Eventually, these additional samples will be analyzed to give a more complete picture of the termite activity in the yard of each property.

**Table 1.** Activity of subterranean termite colonies in and around residential structures in central North Carolina before and after treatment with imidacloprid. In-ground monitors were placed around structures from 1.5 to 75 ft. away from the foundation wall.

House no.	No. soil monitors	No. monitors active	% monitors active	No. colonies in monitors	No. shelter tubes	No. colonies inside bldg.	Total colonies*	No. days for interior activity to cease
1	77	5	6%	5	1	1	5	21
2	89	16	18%	4	4	1	4	7
3	54	5	9%	2	4	2	2	45
4	60	7	12%	8	2	2	8	85
Mean ( $\pm$ SD)	70.0 $\pm$ 16.0	8.3 $\pm$ 5.3	11.3 $\pm$ 5.1%	4.8 $\pm$ 2.5	2.8 $\pm$ 1.5	1.5 $\pm$ 0.6	4.8 $\pm$ 2.5	39.5 $\pm$ 34.2

\* Some colonies were present both inside the structure and in monitoring stations and were counted only once.

## RESULTS

To date, we have preliminary data for four houses. The results for these houses are summarized in Table 1. High levels of termite activity were found prior to treatment at each property with soil monitor hit rate averaging about 11% (Range = 5-18%). Nearly all samples consisted of *R. flavipes*. Of the 21 colonies reported in Table 1, 19 (90.5%) were *R. flavipes* and two were *R. hageni*; the two colonies of the *R. hageni* were present in monitors at House 2. Genetic analysis showed multiple subterranean termite colonies at all properties with up to eight colonies observed at one site, and up to two colonies infesting a structure simultaneously. Termite colonies inside buildings were also found in soil monitors located at distances of 1.5 - 28 ft. from the foundation wall.

The application of imidacloprid at 0.05% as a perimeter only or as a perimeter plus limited interior treatment resulted in a rapid decline of termites inside each building with complete elimination of all known interior infestations within 7 - 85 d. The structure requiring 85 d for elimination (House 4, Table 1) was characterized by excessive moisture at the time of application which prevented treatment to one side of an interior foundation wall separating two units. Termites in the shelter tube at that site were symptomatic of imidacloprid poisoning and were moving slowly 1 wk before activity ceased.

Termite activity in the soil monitors placed along the foundation and in the yard of each property was also severely impacted following imidacloprid treatment. In fact all active monitors at every test site became inactive 21-80 d after treatment, even those located 17-50 ft. from the foundation wall. It was even observed that termite colonies detected in the outer ring of monitors, and distinct from colonies inside the structure, also disappeared following treatment.

## DISCUSSION

These preliminary results show that in central North Carolina, there can be up to eight subterranean termite colonies in close proximity to structures, and that attacks on a single house can come from at least two different colonies simultaneously. Imidacloprid application resulted in quick elimination of termite activity inside and outside the buildings with wide ranging effects on colonies up to 50 ft. away from the treatment area. Long-term monitoring and genotyping of all 12 of the houses over the next 2-3 yr will provide a rigorous assessment of colony elimination by imidacloprid treatment.

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