Laboratory Evaluation of Baits, Residual Insecticides, and an Ultrasonic Device For Control of White-Footed Ants, *Technomyrmex albipes* (Hymenoptera: Formicidae)

by

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ABSTRACT

Experimental and commercial baits, gels, residuals, one insecticidal dust, and an ultrasonic pest repeller were compared in laboratory tests for control efficacy against containerized sub-colonies of white-footed ants, *Technomyrmex albipes*. NecDew™, an experimental bait with 10 ppm thiamethoxam, reached 62% mortality at 8 days, and 100% mortality at 35 days, and would therefore likely achieve an acceptable level of control in the field. Other baits yielding high mortality were imidacloprid in 25% (w/v) sucrose water, NecDew™ with 10,000 ppm DOT, 10 ppm thiamethoxam in 25% (w/v) sucrose water, and Terro Ant Killer II. Results from the other baits, residuals, gels, insecticidal dust, and the ultrasonic pest repeller were all unsatisfactory.

Implications for field efficacy against white-footed ants are discussed.

Key words: sugars, borates, ant baits, NecDew™, Florida

INTRODUCTION

Since their discovery in Homestead, Florida, in 1986 (Deyrup 1991), white-footed ants (WFA), *Technomyrmex albipes* (Fr. Smith 1861), have expanded their range throughout much of the state (Fig. 1). Isolated or mostly indoor populations have been documented in San Francisco, California (P. Ward, personal communication 2003), Georgia, North Carolina, and Grand Cayman (unpublished records 2004).

Although the efficacy of control products has not previously been studied for WFA, several studies have been performed on dolichoderine and other ants. Forschler and Evans (1994) assessed bait control for Argentine ants (*Linepithema humile* Mayr), using 0.5% sulfuramid in a peanut butter matrix and 0.9% hydramethylnon in an insect pupae-fish matrix, and found that both treatments eliminated foraging activity in 6 weeks. Klotz and Moss (1996) evaluated a liquid 1% boric acid bait

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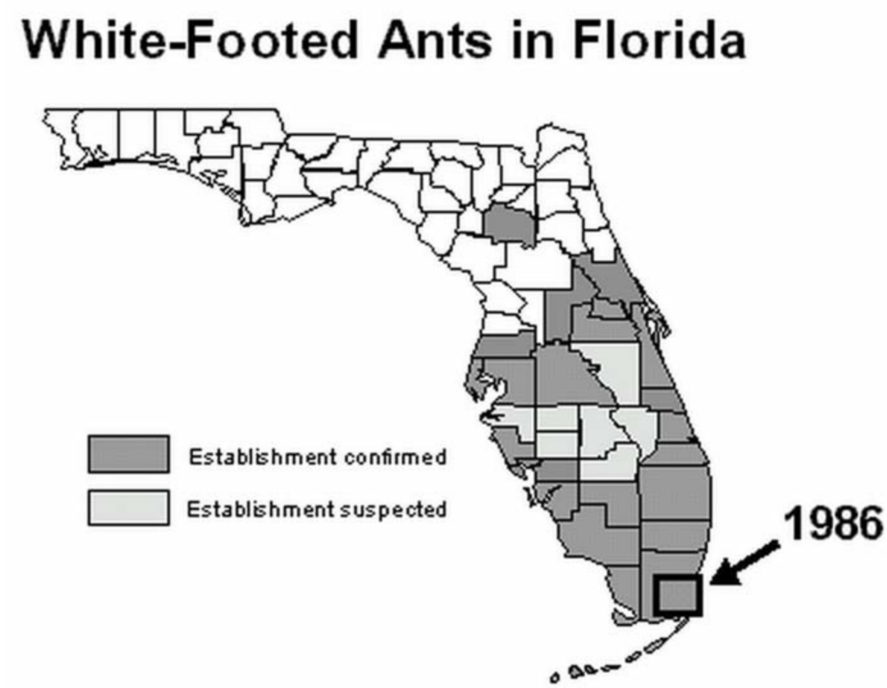

Fig. 1. Distribution of *Technomyrmex albipes* by Florida counties as of August 2004. Dade County site of first discovery in 1986.

in 10% sucrose and 0.9% hydramethylnon granular bait in silkworm pupae granules on colonies of ghost ants [*Tapinoma melanocephalum* (Fabricius)], Argentine, and Pharaoh ants [*Monomorium pharaonis* (Linnaeus)] in no-choice laboratory tests done on small colonies. They found that boric acid baits need to be available to the ants for more than three days to effectively eliminate colonies of the species tested. The hydramethylnon bait eliminated the Pharaoh ant colonies, and reduced the numbers of Argentine ants, but had no effect on *T. melanocephalum*. Klotz *et al.* (1998) baited 3 buildings infested with Argentine ants. Two of the buildings were baited with 0.5% boric acid in 25% sucrose water and the remaining building with 25% sucrose water as control. After 8-10 weeks an 81% reduction of ants in the treated buildings was observed *vs.* a 31 % decrease in the untreated buildings. Klotz *et al.* (1998) stated that a complete elimination of ants was not achieved because of the large initial ant population and the continuous arrival of new colonies. In another test, 0.5% boric acid in 20% sucrose water provided 100% mortality of Argentine ant workers and queens (M.K.

Rust, pers. comm. cited in Klotz *et al.* (1998)). This supports the long-accepted hypothesis that a slow-acting toxicant is a prerequisite for an effective ant bait (Stringer *et al.* 1964), at least for Argentine ants. Klotz *et al.* (2000) and Klotz and Moss (1996) also conducted toxicity tests using boric acid and sugar solutions against Florida carpenter ants, *Camponotus floridanus* (Buckley).

This paper describes laboratory studies against boxed colonies of WFA to test the control efficacy of a number of commercial and experimental ant control products.

MATERIALS AND METHODS

WFA adults and brood were collected from thatch of phoenix roebelenii palms [*Phoenix roebelenii* O'Brien] at the University of Florida Fort Lauderdale Research and Education Center (Broward Co., FL). Ants were collected between 09:00 and 15:00, when most of the foragers were in the nests. Infested thatch was held in a plastic 100-l garbage pail with a 28 cm dia. hole cut into the center of its lid. The upper interior surface of the pail was coated with Vaseline® to retard the ants' escape. Ants were separated from thatch using a plastic container (30 x 23 x 10 cm) which was supported over a water moat (Fig. 2). Infested thatch material was taken from the pail, placed in the container, covered with 1 x 15 cm strips of wood and a separator panel of 3-mm-thick polycarbonate with numerous 2 mm holes. Dripping water from a 2-l tank suspended over the container slowly forced the ants to leave the thatch and enter nesting tubes above the panel. Nesting tubes (10 x 75 mm, clear polystyrene test tubes, Fisher Scientific, Pittsburgh, PA), were each filled at the bottom with a small cotton ball soaked with 25% (w/v) aqueous sucrose, and except for the opening, covered with aluminum foil. Six nesting tubes were sandwiched between Styrofoam panels. When filled with workers and brood, tubes were placed in a 37-l holding tank provisioned with 25% (w/v) aqueous sucrose and chicken baby food (Chicken & Chicken Broth, BeechNut Nutrition Corp., Canajoharie, NY).

Nalgene™ reusable plastic utility boxes (19 x 16 x 10 mm, Fisher Scientific) with two-piece lids served as test containers for WFA sub-colonies. The interior lid had a 12 x 7.5 cm section removed and covered with a fine cloth mesh and the exterior lid had six holes (6.35 mm ID) for aeration and a thin film of Vaseline along the edge to retard ant escape. Nesting tubes with about 200 ants and dozens of brood pieces were placed at the bottom of each box, held in place with a small amount of Handi-Tak® (Pacer Technology, Rancho Cucamonga, CA). Ants were

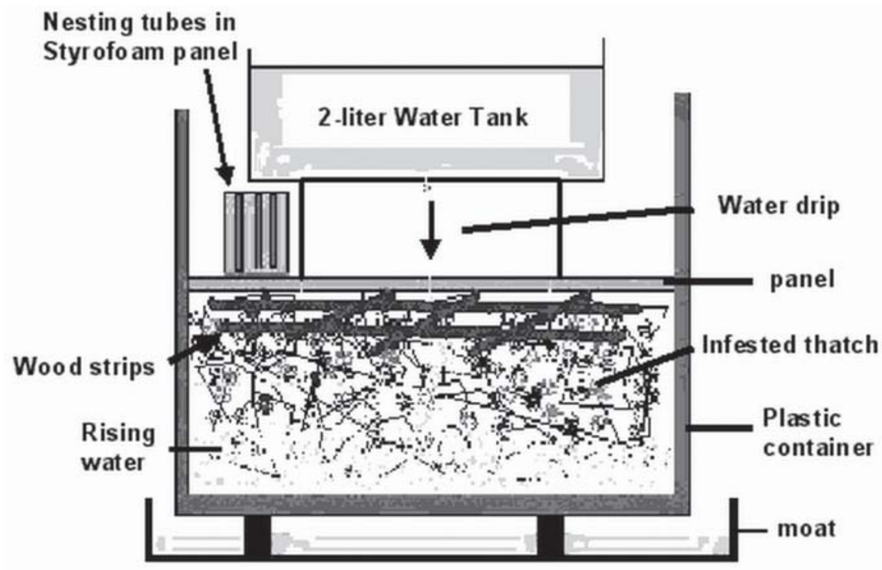

Fig. 2. Device used to displace ants from palm thatch to nesting tubes

provisioned with water by placing a small cotton ball moistened with approximately 2 ml deionized water in a 4.4 x 4.4 x 0.7 cm polystyrene weighing dish (Fisher Scientific).

Sugar water and toxic liquid baits (see below) were fed via 6 ml glass shell vials with Titeseal® plastic caps (Fisher Scientific). Five holes (0.86-mm ID) were drilled into each cap to provide feeding access to liquids without permitting ants to enter the vials. Vials were filled with 4.5 ml bait solution, inverted, and attached to the sides of the boxes with Handi-Tak®. Sugar water was fed *ad libitum* to the ants at all times and supplemented twice weekly by live termites or chicken baby food. An absorbent felt pad (47 mm dia.) was placed under each vial to catch errant drops and prevent ants from entrapment in sticky residue. Ants were allowed to acclimatize in boxes for several weeks before testing. Each day dead ants were removed and replaced with equal numbers of live ants. When ant populations appeared stable, treatments were applied. No ants were added during the experiment and ants were not starved before testing.

Each box to receive a liquid bait treatment also contained a 25% aqueous sucrose vial on the right rear wall, along with the toxic bait vial on the left rear wall of the colony box (Fig. 3). Boxes with gels had the gels in 4.4 x 4.4 x 0.7 cm weighing dishes. The weighing dishes were

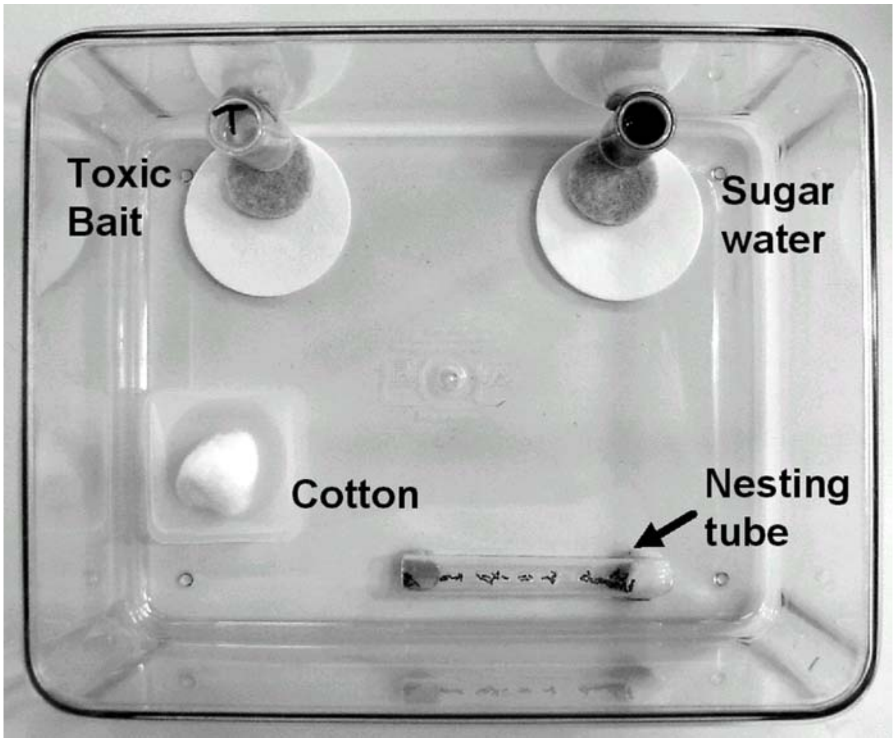

Fig. 3. Toxic bait bioassay

placed on the left side of the box, and the untreated sugar water vials were on the right side. Surface residual treatments were applied to 7.7 x 5 x 0.3 cm basswood panels, that were previously painted with white latex paint (Behr Premium Plus Exterior Flat, Behr Process Corp., Santa Ana, CA), to simulate a typical house exterior (Fig. 4). These rectangles covered approximately 20% of the bottom foraging areas of the boxes, and ants could travel between food and nesting tubes without contacting residual deposits. For aqueous solutions, 0.17 ml (near run-off volume) was deposited on panels and distributed evenly with a fine paintbrush previously saturated in solution, and allowed to dry 24 h before exposure to the ants. The dust treatment (deltamethrin) was applied to panels with a Power-Puff® (Gremar, Inc., West Des Moines, IA) electric duster for 3 seconds. Five replications of imidacloprid ant bait instant granules were prepared in non-randomized colony boxes because the product was included last minute. Some of the products were purchased over-the-counter, others were supplied by

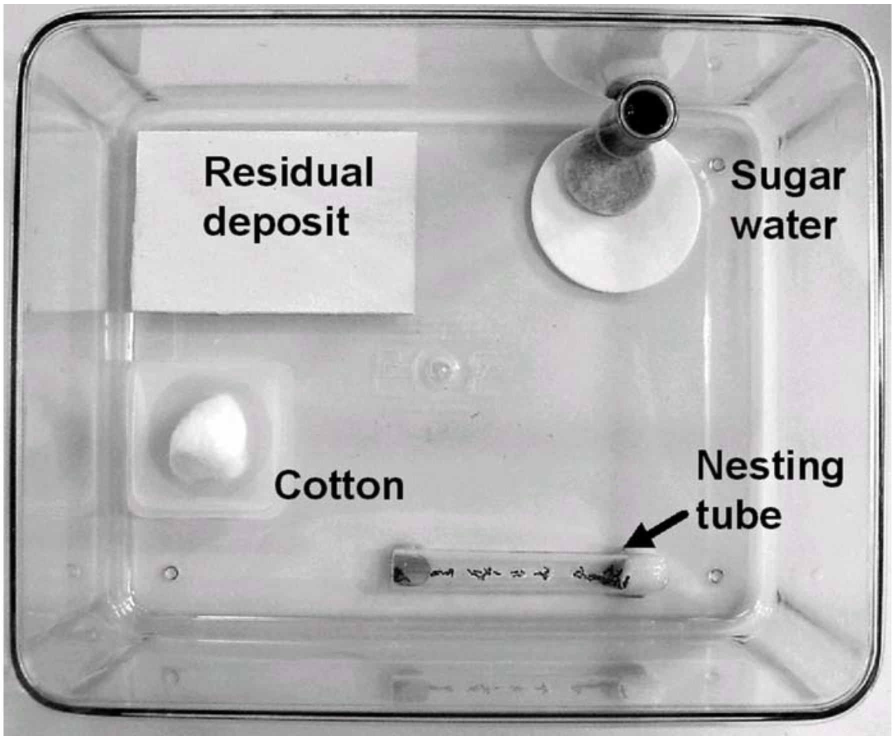

Fig. 4. Residual deposit bioassay

chemical manufacturers, and NecDew™, a proprietary sweet bait that mimics natural nectars and honeydews, was developed at the University of Florida as a liquid bait for pest ants. The results of preference tests (Warner & Scheffrahn 2004), were considered in choosing some of the materials to be tested. Two laboratory tests were performed to determine which of the products tested showed the greatest promise as a possible control agent for this pest species.

Fourteen treatments (5 replicates each, assigned randomly) were applied to the ants in 70 boxes on 8 January 2002. Liquid baits formulated in 25% sucrose solution (w/v) included 1 and 10 ppm thiamethoxam (technical 98.9%, Syngenta Crop Protection, Greensboro, NC) and 50 ppm imidacloprid (technical 98.9%, Bayer Environmental Sciences, Montvale, NJ). Commercial ready-to-use liquid baits included Drax Liquidator® (10,000 ppm orthoboric acid, Waterbury Companies, Waterbury, CT), Terro Ant Killer II® (54,000 ppm sodium borate decahydrate (borax), Senoret Chemical Co. Minneapolis, MN), and NecDew™ formula 4 (University of Florida) containing 10,000 ppm disodium octaborate tetrahydrate (DOT, Tim-bor®). Surface treatments included Termidor® SC (600 ppm fipronil, Aventis Environmental Science, Montvale, NJ), Conserve® SC (800 ppm spinosad, Dow AgroSciences, Indianapolis, IN), and Talstar® Lawn and Tree Flowable (600 ppm bifenthrin, FMC Corporation, Philadelphia, PA). Additional treatments included 5,000 ppm noviflumuron (50% SC Dow AgroSciences), suspended in a loose bait gel using 5,000 ppm Phytagel® (Sigma, St. Louis, MO) in 25% (w/v) sucrose-water, and Ultrasonic Pest Repellers (Lentek International, Inc., Orlando, FL). The suspension of noviflumuron was placed into a plastic weighing boat (0.5 g), and replaced twice a week or when it desiccated. One corner was cut away to allow for easier access by ants. Untreated controls included 25% sucrose solution, a water-treated white basswood rectangle, and 5,000 ppm Phytagel in 25% sucrose solution. The "ultrasonic pest repellers" were tested in a separate room to avoid possible influence they might have on the other boxes in the study. Five boxes were placed in a semicircle approximately 30 cm from 3 pest repellers that were plugged into a 110v 5-unit power strip.

In a second trial, 15 treatments (5 replicates each, assigned randomly) were applied to the ants in 75 boxes on 16 May 2002. Liquid baits included PT381B Advance Liquid Ant Bait (54,000 ppm sodium tetraborate decahydrate (borax), Whitmire Micro-Gen Research Laboratories, Inc., St. Louis, MO), imidacloprid ant bait instant granules (50 ppm, Bayer Environmental Sciences) in deionized water (3:1, water: granules), Pre-Empt® (50 ppm imidacloprid, Bayer Environmental Sciences), and 10 ppm thiamethoxam (Syngenta Crop Protection) in NecDew™ formula 4 (University of Florida). Surface treatments included Termidor® SC (1,200 ppm fipronil, Aventis Environmental Science), 500 ppm indoxacarb (15% SC DuPont, Wilmington, DE), DeltaDust© (500 ppm deltamethrin, Aventis Environmental Science), and Demand® CS (600 ppm lambda cyhalothrin, Syngenta Crop Protection). Additional treatments included Maxforce® Ant Bait Gel (10 ppm fipronil, Maxforce Insect Control Systems, Oakland, CA), Combat® Quick Kill, (100 ppm fipronil, Combat Insect Control Systems, Oakland, CA), over-the-counter ant bait stations, 5,000 ppm noviflumuron SC (50% SC Dow AgroSciences), used as a suspension bait in honey-water (1:1), 500 ppm indoxacarb (15% DuPont, Wilmington, DE) as a suspension in honey-water (1:1), and liquid bait, surface, and gel untreated controls. One-half g noviflumuron and indoxacarb baits were placed into the bulb of 9.3 ml, large-tip opening transfer pipettes (Samco®, San Fernando, CA) having had 8 cm cut back from the tip.

Dead ants were removed from all colony boxes and counted daily for the first week, then twice weekly thereafter. At the end of each experiment, all ants still living were killed with ethanol and counted to determine the total number of ants in each box. Natural growth or decline of box populations was not determined because the initial number of ants in each box was not known. Mean percent mortalities were analyzed by ANOVA and general linear model (SAS Institute 1989, SAS/STAT user's guide, version 6, 4th ed. SAS Institute, Cary, N.C.) and means separated using Student-Newman-Keuls test at $P<0.05$.

RESULTS

Mortalities for the first trial were recorded for 51 days. Mean percent mortality for each treatment at 1, 3, 7, 30, and 51 days after exposure were selected to be representative of the exposure time course and are given in Table 1. One day after exposure, Talstar® had the highest percent mortality (7.60 ± 3.1%), but it was not significantly different from imidacloprid (4.92 ± 4.02%), 10 ppm thiamethoxam (4.44 ± 2.26 %), NecDew™ + DOT (4.07 ± 3.10%), or noviflumuron (3.63 ± 2.17%), and only the percent mortality from Talstar® was significantly greater than that of the controls. Three days after exposure, percent mortality was significantly greater for NecDew™ + DOT (26.55 ± 13.36%) than all other treatments. On Day 7, the percent mortality for NecDew™ + DOT continued to be significantly greater at 48.81 ± 14.86% than all other treatments, followed by 10 ppm thiamethoxam (38.81 ± 11.13%) and imidacloprid (29.84 ± 10.63%), the later not being significantly different from Terro® (21.22 ± 9.22%).

After 51 days imidacloprid (90.86 ± 5.43%), NecDew™ (86.95 ± 6.05%), 10 ppm thiamethoxam (84.40 ± 10.09%) and Terro© (75.51 ± 7.01%) were the only treatments that produced significantly higher mortality than the controls. Talstar®, noviflumuron, 1 ppm thiamethoxam, Drax, the pest repeller, Spinosad, and Termidor® mortalities were not significantly different from the control treatments. Ants in 3 of the 5 pest repeller boxes moved to nest against a box wall closer to the repellers.

Mortality for the second trial was recorded for 47 days. Mean percent mortality for each treatment at 1, 2, 8, 29, and 47 days after exposure were selected to be representative of the exposure time course and are given in Table 2. The NecDew™ + 10 ppm thiamethoxam treatment had the highest mean mortality and yielded significantly greater mortality than all other treatments for the entire testing period. At one day after exposure, only mortality from NecDew™+ 10 ppm thiamethoxam (9.57 ± 5.59%) was significantly greater than any of the controls. Two days

Table 1. Mean percent mortality (± SD)[a] of *Technomyrmex albipes* adults after 1, 3, 7, 30, and 51 days exposure to 14 treatments in a non-forced bioassay, January-February, 2002

		Days				
Treatment	Type[b]	1	3	7	30	51
Talstar® Flowable 600 ppm	R	7.60 ± 3.10a	11.69 ± 5.47bcd	14.13 ± 3.92de	28.48 ± 4.44bc	46.77 ± 7.35bc
Imidacloprid 50 ppm	B	4.92 ± 4.02ab	14.06 ± 7.40b	29.84 ± 10.63bc	78.55 ± 4.83a	90.86 ± 5.43a
Thiamethoxam 10 ppm	B	4.44 ± 2.26ab	18.33 ± 8.49b	38.81 ± 11.13b	64.77 ± 15.51a	84.40 ± 10.09a
NecDew™ +DOT 10,000 ppm	B	4.07 ± 3.10ab	26.55 ± 13.36a	48.81 ± 14.86a	76.99 ± 11.43a	86.95 ± 6.05a
Noviflumuron 5,000 ppm	B	3.63 ± 2.17ab	5.44 ± 2.48cd	10.22 ± 4.97de	27.25 ± 8.69bc	42.96 ± 11.78bcd
Terro® 54,000 ppm	B	3.17 ± 4.66b	6.83 ± 5.80cd	21.22 ± 9.22cd	63.94 ± 7.99a	75.51 ± 7.01a
Thiamethoxam 1 ppm	B	1.66 ± 1.17b	3.64 ± 2.80cd	6.44 ± 4.73e	19.73 ± 9.98c	44.02 ± 13.73bcd
Control bait	B	1.37 ± 0.73b	2.81 ± 0.98cd	4.72 ± 1.34e	18.33 ± 4.19c	38.82 ± 5.25bcd
Control surface	R	1.36 ± 0.63b	3.73 ± 1.72cd	5.71 ± 2.05e	24.24 ± 6.65bc	43.99 ± 7.07bcd
Drax® 10,000 ppm	B	1.23 ± 1.16b	4.79 ± 4.14cd	15.37 ± 13.16de	37.68 ± 12.88b	54.18 ± 12.16b
Pest repeller		1.05 ± 0.67b	4.49 ± 4.08cd	6.46 ± 4.24e	14.23 ± 9.05c	27.79 ± 13.20d
Conserve SC 800 ppm	R	1.01 ± 0.87b	2.02 ± 0.83d	3.78 ± 1.85e	16.15 ± 3.78c	34.51 ± 2.42cd
Termidor® SC 600 ppm	R	0.98 ± 0.70b	3.46 ± 1.38cd	6.76 ± 2.25e	27.88 ± 5.89bc	53.76 ± 10.84b
Control gel	B	0.88 ± 0.39b	2.11 ± 0.88d	5.26 ± 2.07e	19.29 ± 7.91c	38.97 ± 12.08bcd
Treatment Effects Statistics						
F		3.99	8.72	17.28	35.84	24.33
df		13, 70	13, 70	13, 70	13, 70	13, 70
P		0.0001	0.0001	0.0001	0.0001	0.0001

[a] Means of 5 replicates, N = 202.49, SD = 68.41. Means within a column followed by the same letter are not significantly different (Student-Newman-Keuls test) at P = 0.05.

[b] R= residual treatment on 5 x 7.7 cm painted wood panels, B= bait in sweet base.

Table 2. Mean percent mortality (± SD)[a] of *Technomyrmex albipes* adults after 1, 2, 8, 29, and 47 days exposure to 15 treatments in a non-forced bioassay, May - July, 2002

		Days				
Treatment	Type[b]	1	2	8	29	47
NecDew™ + THXM.10 ppm	B	9.57 ± 5.59a	19.93 ± 5.03a	62.45 ± 10.79a	97.81 ± 3.36a	99.91 ± 0.21a
Combat Bait Station 100 ppm	S	4.48 ± 2.56b	7.62 ± 3.94bc	13.66 ± 5.85bc	23.35 ± 7.70cde	32.78 ± 8.25de
Pre-Empt® 50 ppm	B	4.16 ± 2.83bc	10.41 ± 9.31b	21.58 ± 11.63b	60.48 ± 15.40b	81.65 ± 13.18b
Maxforce® Ant Gel 10 ppm	S	2.99 ± 1.67bcd	4.91 ± 0.98bc	7.60 ± 1.84bc	18.77 ± 4.44de	32.95 ± 10.48de
Indoxacarb in Honey 500 ppm	S	2.93 ± 1.98bcd	5.59 ± 3.16bc	12.31 ± 6.13bc	37.22 ± 7.03c	52.03 ± 8.26c
Termidor® 1200 ppm	R	2.90 ± 2.45bcd	4.10 ± 2.80c	8.01 ± 4.44bc	20.69 ± 5.67de	32.01 ± 7.16de
Indoxacarb surface 500 ppm	R	2.19 ± 2.42bcd	2.56 ± 2.51c	5.61 ± 4.96c	16.59 ± 12.72de	27.87 ± 14.59e
Control Maxforce® Gel blank	B	1.97 ± 1.98bcd	2.75 ± 2.63c	5.95 ± 5.57c	16.90 ± 8.80de	30.24 ± 6.79de
Control surface	S	1.62 ± 0.62bcd	2.10 ± 0.94c	4.95 ± 2.38c	16.10 ± 5.15de	29.38 ± 4.94de
Demand® CS 600 ppm	R	1.40 ± 1.01bcd	1.95 ± 1.16c	4.27 ± 2.18c	14.44 ± 7.97de	24.69 ± 8.19e
DeltaDust® 50 ppm	R	1.22 ± 1.01bcd	1.48 ± 1.29c	3.81 ± 2.29c	10.53 ± 5.01e	20.64 ± 5.08e
Noviflumuron 5,000 ppm	S	0.98 ± 0.70bcd	1.35 ± 0.91c	4.72 ± 2.47c	14.72 ± 5.14de	29.68 ± 5.85de
Advance® Ant Bait 54,000 ppm	B	0.65 ± 1.28cd	2.03 ± 3.78c	15.00 ± 16.92bc	32.71 ± 19.08cd	47.11 ± 20.19cd
Control bait	B	0.30 ± 0.31d	1.07 ± 1.23c	3.18 ± 2.93c	10.67 ± 6.17e	20.41 ± 6.50e
Imidacloprid IG** 50 ppm	B	-------------------	1.63 ± 1.15c	14.11 ± 8.66bc	61.97 ± 16.01b	84.46 ± 6.73b
Treatment Effects Statistics						
F		8.90	10.30	20.72	31.94	34.93
df		14,75	14,75	14,75	14,75	14,75
P		0.0001	0.0001	0.0001	0.0001	0.0001

[a] Means of 5 replicates, N = 340.87, SD = 86.48. Means within a column followed by the same letter are not significantly different (Student-Newman-Keuls test) at P = 0.05. **Non-randomized treatment initiated 1 day after other treatments.

[b] R= residual treatment on 5 x 7.7 cm painted wood panels, B= bait in aqueous sucrose base, S= suspension in honey or commercial gel.

after exposure, both NecDew™+ 10 ppm thiamethoxam (19.93 ± 5.03%), and Pre-Empt© (10.41 ± 9.31%) produced mortality that was significantly greater than controls. This same trend continued until day 29 when mortality from NecDew™+ 10 ppm thiamethoxam reached 97.81 ± 3.36%, and imidacloprid instant granules (61.97 ± 16.01%) exceeded that of Pre-Empt© (60.48 ± 15.40%). Except for indoxacarb in honey (37.00 ± 7.03%), mortalities in the remaining treatments were not significantly different from any of the controls.

At day 47, NecDew™+ 10 ppm thiamethoxam had the highest percent mortality at 99.91 ± 0.21%, which was significantly greater than all the other treatments. Except for NecDew + 10 ppm thiamethoxam, only imidacloprid instant granules (84.46 ± 6.73%), Pre-Empt© (81.65 ± 13.18%), and indoxacarb in honey (52.03 ± 8.26%) yielded significantly greater mortality than any of the controls. Treatments with mortalities not significantly different than the controls included Combat bait stations, Maxforce® ant gel, Termidor®, indoxacarb surface treatment, Demand® CS, DeltaDust®, noviflumuron, and Advance® ant bait.

DISCUSSION

In these experiments, we compared experimental and commercial baits, gels, residuals, one insecticidal dust, and an ultrasonic pest repeller for efficacy against WFA. One of the primary concerns in considering which commercial products to test in this study was whether the products seemed to be popular with pest control companies in the area for use against WFA. For commercial or experimental products supplied directly to us we followed label or manufacturer recommendations for use. Products purchased over-the-counter, such as the ultrasonic pest repellers, and Combat Quick Kill bait stations, were included because homeowners often resort to these in lieu of pest control services.

A typical residential treatment for pest ants requires that the structure be treated with a residual insecticide 0.3-1 meter up and out from its perimeter. Sometimes due to label restrictions and/or operator neglect, the tendency has been to omit the difficult-to-reach nesting areas, such as the crowns of high palm trees, nests deep within thick bushes, or many other protected places. It has been observed (J. Warner unpubl. observ.) that WFA will nest in refugia free of pooling water from precipitation or irrigation. These same areas may be difficult to treat with spray applications. Although ants contacted directly by insecticidal sprays will probably be killed, the results of laboratory tests indicate that even active, fresh insecticidal deposits located within the foraging range do not significantly affect mortality.

On the other hand, a bait having a preferred matrix with an efficient toxicant, will draw the ants out from their cryptic nest sites. Research done in Okinawa, Japan, found that during a year, WFA colony compositions varied from 34.2% to 99.7% sterile workers (Yamauchi *et al.* 1991). A significant reduction of the foragers from among these workers as a result of feeding on toxic baits should substantially reduce nutrient flow to the non-foraging population. This may force non-foragers to seek foods in the environment or consume brood. If a 50% mortality level means the elimination of most of the colony's foragers and therefore a nearly total elimination of the visual population, this may be an acceptable threshold for initial control.

The four baits yielding the highest mortality from January 2002 (Table 1) were imidacloprid, NecDew™ with DOT, 10 ppm thiamethoxam, and Terro. NecDew™ with DOT reached the 50% mortality level in approximately 8 days, while 10 ppm thiamethoxam and imidacloprid reached this level at about 14 days and Terro at about 20 days. Because 10 ppm thiamethoxam was effective in sucrose solution, it was decided to dissolve it in the NecDew™ base for the second test (Table 2). In that test, NecDew™ with 10 ppm thiamethoxam reached the 50% mortality level at 7 days, 98% mortality at 29 days, and 100% mortality at 35 days, and would therefore likely achieve an acceptable level of control in the field. This improvement in the efficacy of NecDew in the second test is possibly because thiamethoxam, at the level used, is either less repellent than DOT, and/or more toxic to WFA. In preference tests, NecDew was found to be highly preferred by WFA over numerous materials tested (Warner & Scheffrahn 2004).

The residual products tested were not as efficacious as the baits in reaching desirable mortality. Being arboreal, it has been observed that WFAs will quickly climb over materials placed in their foraging areas. Although we did not quantify contact, ants were observed crawling on treated surfaces. As seen in the results of the first test (Table 1), fipronil reached 53% mortality at 51 days while bifenthrin yielded 47% mortality. In the second test (Table 2), fipronil was not successful in achieving an acceptable level of control. In practical terms, 51 days is too long to satisfy property owners experiencing WFA infestations. We consider fourteen days to be an acceptable maximum time to achieve an initial control level of 50% colony mortality.

In the present study, mortality was unsatisfactory from 3 of 10 liquid baits, all the residuals and gels, one insecticidal dust, and the ultrasonic pest repellers. Although product specifications for the pest repellers make no claims for ant mortality, only for repellency, they state that 60 days are required for "satisfactory results" and the testing period ran for only 51 days, but because 3 units were used instead of 1 unit, we consider that sufficient time was allowed to produce results. The ultrasonic repellers had the lowest mortality of all products tested (27.79% ± 13.20), including the controls, and the movement of ants in 3 of the 5 boxes to nest against a box wall closer to the repellers indicates that this product would probably be an ineffective choice for WFA control.

New gel ant baits are frequently seen advertised in pest control product catalogs and pest control operators tend to favor their use because gels are easier to apply than liquid baits which must be placed into containers. In a study of Argentine ant intake of gel and liquid bait formulations (Silverman & Roulston 2001), it was found that ants fed eight times longer on gels but consumed five times less sucrose than workers which fed on a liquid sucrose solution. This consumption of greater amounts of sweet liquids and consequentially greater amounts of dissolved toxicants in relation to gels probably helps explain the greater efficacy of liquid baits in our experiments.

Two experiments compared control efficacy of experimental and commercial products against laboratory colonies of white-footed ants, *T. albipes*, and found that the experimental liquid bait, NecDew™ containing 10 ppm thiamethoxam, performed the most efficaciously, reaching 62% mortality at 8 days, and 100% mortality at 35 days. High mortality was obtained from several other liquid baits, including imidacloprid in 25% (w/v) sucrose water, NecDew™ with 10,000 ppm DOT, 10 ppm thiamethoxam in 25% (w/v) sucrose water, and Terro Ant Killer II. Results from other liquid baits tested, several residuals, gels, one insecticidal dust, and an ultrasonic pest repeller were all unsatisfactory.

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