An Evaluation of Several Urban Pest Management Strategies to Control Argentine Ants (Hymenoptera: Formicidae)

by

John H. Klotz[1], Michael K. Rust[1], Les Greenberg[1], Herb C. Field[2], & Ken Kupfer[3]

ABSTRACT

Six insecticide treatments were evaluated for efficacy in controlling heavy infestations of Argentine ants around homes in southern California. All of the treatments significantly reduced ant activity over the course of the 8 wk study. The greatest reductions were achieved at homes that were treated with fipronil. Especially noteworthy was the fipronil spot treatment which reduced ant activity around homes by 90% at 8 wks. Homes treated with liquid borate bait attained a 73% reduction in ant activity at 6 wks, and 83% when combined with a perimeter spray of fipronil. Other combination treatments with fipronil were equally effective, especially bifenthrin granules (90% reduction at 8 wks). At the end of the study 79% of the homeowners rated the treatments as very effective.

Key Words: Argentine ants, ant control, ant baits, insecticide spray

INTRODUCTION

The Argentine ant, *Linepithema humile* Mayr, is an invasive pest with world-wide distribution and major economic and ecological impacts on urban, agricultural, and natural environments (Vega & Rust 2001). In certain areas of the United States, such as California, it is the most frequently encountered ant pest and the most difficult to control (Knight & Rust 1990). For instance in San Diego, over 90% of the service calls made by Lloyd Pest Control for ant problems are to control Argentine ants (Field *et al*. 2006).

Pest management strategies for Argentine ants date back to the late 1800s when they were first introduced into the U.S. in the Port of New Orleans probably off-loaded with cargo from Brazilian coffee ships (Newell &Barber 1913). Toxic bait consisting of syrup and sodium arsenite placed in perforated

[1]University of California, Riverside. Riverside, California 92521
[2]Lloyd Pest Control. San Diego, California 92110
[3]KM AntPro LLC. Nokomis, Florida 34275

paraffined bags or tin cans and attached to trees around infested homes was one of the early methods of control (Barber 1920). Arsenic trioxide is still used today as an active ingredient (AI) in Grant's Kills Ants, which is sold over-the-counter for Argentine ant control (www.cdpr.ca.gov).

More effective control measures for Argentine ants became possible after World War II when chlorinated hydrocarbons became available. For example, chlordane was used to control Argentine ants in both urban and agricultural environments. However, due to its broad-spectrum toxicity and persistence in the environment it was banned in 1978 for use on crops, homes, and gardens. Organophosphates and carbamates followed by synthetic pyrethroids were the next wave of insecticides to be used as perimeter sprays around homes to control Argentine ants. At best, the residual activity of these compounds lasts about 30 days (Rust *et al*. 1996). In 2000 and 2001, the Environmental Protection Agency cancelled the use of chlorpyrifos and diazinon in residential settings, and bendiocarb was voluntarily cancelled by the registrant. Pyrethroids are still used for Argentine ant control but are rapidly being replaced by several new classes of non-repellent insecticides.

One of the more popular non-repellent sprays currently in use by pest control companies as a perimeter treatment for ants around homes contains the active ingredient fipronil, which is sold under the trade name Termidor. In addition to being non-repellent, fipronil is slow-acting, which allows it to be transferred from one ant to another thereby acting as virtual bait (Vail *et al*. 2003). However, the horizontal transfer of fipronil is by contact and not trophallaxis as in the case of a bait toxicant (Soeprono & Rust 2004a,b).

Given the outstanding success of Termidor, there is now minimal use of toxic baits by pest control companies to control ants. However, Termidor is a restricted use insecticide available only to Pest Management Professionals (PMPs), consequently there is still a significant over-the-counter market for ant baits. The liquid baits containing sugars are particularly attractive to Argentine ants, and when formulated with the proper toxicant at the right concentration can be an effective control measure (Rust *et al*. 2003). One of the major challenges currently being met is the development of liquid bait delivery systems with enough capacity to provide continuous bait for the large populations typically found in Argentine ant infestations.

The objective of this study was to evaluate the efficacy of various insecticide treatments to control Argentine ants around homes: specifically Termidor used by itself and in combination with other insecticides, and a liquid bait delivery system used by itself and in combination with Termidor.

MATERIALS AND METHODS

The insecticide treatments to control Argentine ants were applied in July of 2006 around the outside of homes located in the city of Riverside, CA. Each home was monitored periodically for ant activity both before and after treatments for 8 wks. In addition to the treated homes, untreated control sites were also monitored for 8 wks.

Monitoring.

Estimates of ant activity for each home were based on the ants' consumption of 50% sucrose-water (wt/vol), which was provided in 20 numbered 15 ml polypropylene monitoring tubes (Falcon Brand Blue MaxTM Jr. conical tubes [17 x 120 mm], Fisher Scientific, Pittsburgh, PA). Each tube contained 13 ml of sucrose-water and was placed outside, ten approximately evenly spaced around the house adjacent to the foundation and the other ten around the outside perimeter of the yard. The tubes were laid on the ground with the open mouth end propped up in the notch of a small Lincoln Log™ in order to maximize the surface area of liquid available to the ants and reduce their risk of drowning. The tubes were covered with clay or plastic pots (15.5 cm diam. x 11.5 cm high) to protect them from sprinkler irrigation and pets. The amount of sucrose-water consumed by the ants was determined by measuring the weight loss from the tubes over 24 h, and then correcting for evaporation. The correction for evaporative water loss was based on the weight loss from another set of tubes containing sucrose-water placed outside for 24 h without access to ants. Based on laboratory studies conducted by Reierson *et al*. (1998), Argentine ants consume on average 0.3 mg sucrose-water per visit. This average consumption was used to calculate the number of ant visits to each tube over 24 hours. This monitoring procedure was conducted to assess ant activity at each home before treatment, and 1, 2, 4, 6, and 8 wks after treatment.

Treatments

Six different insecticide treatments, each replicated five times, were applied around the outside of homes with heavy infestations of Argentine ants:

(1) Perimeter spray with 0.06% fipronil: 3-4 gallons of Termidor SC (BASF, Florham Park, NJ) applied with a 5-gallon backpack sprayer (Birchmeier Co., Switzerland) along the foundation (one foot up and one foot out), around door and window frames, and to ant nests and trails along the edges of the sidewalks and driveway.

(2) Liquid bait delivery system with 1% disodium octaborate tetrahydrate (DOT): 6-7 AntPro bait stations (KM AntPro, Nokomis, FL), each containing 16-ounces of Gourmet Liquid Ant Bait (Innovative Pest Control Products, Boca Raton, FL) were placed around the outside perimeter of the house and in the yard.

(3) Combination of treatments (1) and (2): 4 AntPro bait stations placed in the yard outside the spray zone of Termidor.

(4) Combination of treatment (1) and 0.2% bifenthrin granules: Talstar EZ Granules (FMC Corp., Philadelphia, PA) broadcasted at 2.3 lbs./1000 sq. ft. on foliage outside the spray zone of Termidor.

(5) Combination of treatment (1) and 0.004% cyfluthrin spray: Cy-Kick CS (Whitmire Micro-Gen, St. Louis, MO) power-sprayed at 5-10 gal/1000 sq. ft. on foliage outside the spray zone of Termidor.

(6) Spot treatment with 0.06% fipronil: 1-gal. Termidor applied with a backpack sprayer to active ant trails around the outside perimeter of the house and in the yard.

A seventh treatment consisted of four untreated control sites, which included a house in Riverside and three office buildings located on the campus of the University of California, Riverside. Unlike the treated homes described above, the control sites had light infestations with far less numbers of Argentine ants. These sites lacked outdoor pets, vegetation with hemipteran pests, and conditions conducive to Argentine ants.

Post-treatment survey.

At the end of the 8 wk study, the homeowners who participated were mailed a short three-question survey form. They were asked to rate the degree of infestation and the incidence of ants inside their home both before and

after the treatments, as well as the overall efficacy of the treatment and any additional comments they might have on the study.

Statistical Analysis. Ant counts at each monitoring station before treatment were compared with counts at those same stations after treatment with a Wilcoxon-Signed Ranks Test ($P<0.05$) (StatView 1999).

RESULTS AND DISCUSSION

Overall the homeowners rated the insecticide treatments as effective: with 79% of the returned survey forms (15/19) indicating "very effective," 21% (4/19) "somewhat effective," and none with "no effect." All of these homes had major ant infestations before treatment with an average of >25,000 ant visits per monitor over a 24-h period (Table 1).

The perimeter spray with fipronil (treatment 1) reduced ant activity near the house by 93% within one week. At 6 wks there was still > 90% reduction, diminishing to 81% at 8 wks (Table 1). The ant activity away from the house that was outside the fipronil spray zone was reduced but not as dramatically. All of the homeowners who received this treatment reported ants inside their house before but not after treatment. One homeowner commented: "The program is life-changing! I no longer have the incredible vigilance and cleaning associated with being overrun with ants."

The combination of perimeter spray with fipronil and broadcasted bifenthrin granules (treatment 2) reduced ant activity near the house by 90% 8 wks after treatment. Away from the house there was generally less ant activity when compared to treatment 1 (Table 1). The other combination with cyfluthrin (treatment 3) was consistently less effective at reducing ant activity both near and away from the house. The spot application of fipronil (treatment 4) provided 90 % reduction of ant activity near the house at 8 wks, and 40% reduction away from the house (Table 1).

The liquid ant bait (treatment 5) reduced ant activity near the house by 73% at 6 wks and 58 % at 8 wks. Ant activity away from the house remained at a high level 4wks after treatment possibly due to ants migrating onto the property from surrounding areas to feed on the bait. When the bait was combined with a perimeter spray of fipronil (treatment 6) the ant activity was consistently less near and away from the house than with the bait treatment alone.

Table 1. Effectiveness of treatments to control Argentine ants around homes in Riverside, California.

Treatment, %AI[a] 7/10/2006	Avg. ant visits per tube before[b] 7/7	Monitoring Site[c]	Avg. ant visits per tube (% reduction) at week after[d] 1 7/18	2 7/25	4 8/8	6 8/22	8 9/7
(1) Perimeter, 0.06 fipronil	26,653	Near	1,846 (93)***	1,254 (95)***	414 (98)***	1,508 (94)***	5,072 (81)***
	31,120	Away	16,740 (46)***	21,160 (32)*	16,883 (46)***	13,505 (57)***	20,123 (65)***
(2) Perimeter, 0.06 fipronil	33,160	Near	1,223 (96)***	6,226 (81)***	2,511 (92)***	775 (98)***	3,247 (90)***
Broadcast, 0.2 bifenthrin	34,392	Away	9,085 (74)***	17,219 (50)***	9,585 (72)***	9,897 (71)***	14,414 (58)***
(3) Perimeter, 0.06 fipronil	28,852	Near	8,181 (72)***	18,382 (36)**	9,611 (67)***	8,052 (72)***	16,947 (41)***
Powerspray, 0.004 cyfluthrin	32,948	Away	18,470 (44)***	25,842 (22)	18,190 (45)***	17,392 (47)***	20,994 (36)***
(4) Spot, 0.06 fipronil	29,548	Near	20,792 (30)**	19,621 (34)**	4,130 (86)***	7,093 (76)***	3,024 (90)***
	34,635	Away	19,355 (44)***	22,991(34)***	14,210 (59)***	20,703 (40)**	20,703 (40)**
(5) Bait, 1.0 DOT	25,036	Near	11,319 (55)***	14,462 (42)*	13,949 (44)*	6,687 (73)***	10,434 (58)***
	28,822	Away	23,933 (17)*	33,258 (0)*	18,352 (36)**	9,884 (66)***	26,509 (8)
(6) Perimeter, 0.06 fipronil	26,068	Near	5,638 (78)***	13,249 (49)**	3,587 (86)***	4,496 (83)***	5,042 (75)***
Bait, 1.0 DOT	30,107	Away	17,484 (42)**	23,710 (21)	14,953 (50)***	8,717 (71)***	12,680 (58)***
Untreated	7,996	---	3,513 (56)*	4,253 (47)	3,919 (51)*	5,151 (36)	1,839 (77)**

[a]Fipronil = Termidor; bifenthrin = Talstar; cyfluthrin = Cy-Kick; DOT = Gourmet. Five homes, each with 20 monitor tubes, for each treatment.
[b]Based on evaporation-corrected weight removal of 50% sucrose water from monitor tubes.
[c]10 monitor tubes were placed near the house and 10 away from the house; ---, indicates no away or near sites.
[d]Wilcoxon Signed Rank Test, * = P<0.05, ** = P<0.01, *** = P<0.001.

The performance of these treatments is based on how thorough the AIs are distributed to the ant population. The effect of fipronil, for example, is maximized by high foraging activity on treated surfaces, because the ants pickup the AI and transfer it to other ants that they contact; thus, the importance of

target applications of this material along structural guidelines where the ants tend to trail. The potency of a target application of fipronil is demonstrated by the spot treatment, which reduced ant activity by 90% at 8 wks with only 1/4 the amount of insecticide as was used in the perimeter treatment.

The performance of baits is also maximized by high foraging activity, although in this case so that the ants consume the AI and distribute it to other ants by trophallaxis. The borate (1% DOT) used in this study is particularly slow-acting, and along with the large numbers of ants around these homes and the additional ones that were migrating in to feed on the bait resulted in higher ant activity than other treatments. However, the baiting program is designed as a long-term management program to be carried out over an entire season.

The combination of a perimeter spray with fipronil and broadcasted bifenthrin granules achieved the greatest reduction of ant activity around the homes. It is unknown why the performance of the other combination treatment with cyfluthrin was consistently lower than fipronil used by itself.

Unseasonable summer temperatures probably contributed to the decreases in ant numbers around buildings in the untreated controls. These structures are on minimal irrigation and the loss of hemipteran insects feeding on plantings and weeds because of the excessive heat were responsible for low ant numbers by September. The declines were not observed at homes in another study with experimental baits that did not provide control.

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