Low Impact Directed Sprays and Liquid Baits to Control Argentine Ants (Hymenoptera: Formicidae)

by

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

ABSTRACT

Insecticide treatments were evaluated for efficacy in reducing outdoor infestations of Argentine ants around homes in southern California. Treatments were applied with the goal of reducing the amount of insecticides applied to control ants. Most effective was an experimental liquid bait formulated with 0.003% thiamethoxam as the toxicant. It reduced the ant numbers near the house by 84% and in the yard by 80%. Similar levels of control were obtained near the house with the same bait containing a lower concentration of AI (0.001%), and two other treatments using low volume applications of fipronil sprays. In the yard, though, these treatments were less effective. The results show that less insecticide and more target specific applications can be used effectively to control Argentine ants outdoors. A cost analysis indicated that a standard industry treatment cost 40% less than baiting.

Key Words: *Linepithema humile*, ant control, ant baits, insecticide spray

INTRODUCTION

The Argentine ant, *Linepithema humile* Mayr, is a significant urban pest in the Southeast and along the West Coast of the United States. In California, surveys indicate that Argentine ants are the most common ant pest encountered by pest management professionals (Knight & Rust 1990), and make up 85% of the ants collected at service accounts of the largest pest control firm in San Diego (Field *et al*. 2007). Infestations around homes in southern California can attain tremendous levels with averages of around 0.5 million ant visits to bait stations daily (Reierson *et al*. 1998).

To control these massive infestations around homes Pest Management Professionals (PMPs) typically apply perimeter sprays of Termidor (0.06%

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

fipronil) or synthetic pyrethroids such as Talstar (0.06% bifenthrin). In previous studies we determined that these products and various others can significantly reduce ant numbers, but that various modifications of the standard perimeter treatment could be made in order to reduce the volume of insecticide used and improve efficacy (Klotz *et al*. 2007, 2008). For example, using Termidor sprays we achieved the same level of ant control with 25% the amount of insecticide as in a perimeter treatment by spraying only active ant trails, thereby facilitating horizontal transfer of fipronil (Soeprono & Rust 2004a,b; Choe & Rust 2008). This kind of approach with directed sprays is more target-specific, minimizes waste, and may potentially reduce insecticide runoff, all important factors to be considered given the increasing environmental concerns with pesticide use.

In this study we continued our evaluation of directed sprays and liquid baits with the objective of reducing the amount of insecticide applied and developing more effective Argentine ant control strategies with even lower environmental impact. We also include a cost analysis comparing a baiting program to a standard industry treatment.

MATERIALS AND METHODS

The experimental design and monitoring procedure are the same as used in two previous field studies on the efficacy of various treatment strategies to control Argentine ants around homes in Riverside, California (for details see Klotz *et al*. 2007, 2008). Briefly, Argentine ant numbers around homes in Riverside, California, were monitored before and at various dates after treatment (1, 2, 4, and 8 wks) to determine their percent reduction. Each treatment was repeated at five homes. Untreated control sites were also included in the study and monitored along with treated sites. Control sites provide information concerning the levels of ant activity and colony development during the study period.

Monitoring

Ant numbers around homes were monitored using vials of sucrose water, 10 placed equidistant from one another around the exterior foundation (near), and 10 additional vials placed out in the yard about 5 m from the structure (away). Each vial contained 13 ml of sucrose water and was covered with a clay

flowerpot to minimize disturbance and ambient light and protect the vials from irrigation. The vials were left in place for 24 hours and then collected to measure the amount of sucrose water consumed by the ants. Reierson *et al*. (1998) determined that on average an Argentine ant consumes 0.3 mg of sucrose water per visit, which along with the total consumption can be used to calculate the number of ant visits per vial over the 24-hour monitoring period.

Treatments

Five treatments to control Argentine ants were evaluated for efficacy:

(1) A perimeter treatment using 3.8 liters of Termidor (0.06% fipronil, BASF, Florham Park, NJ) applied in a pin-stream with a 15-liter backpack sprayer (Birchmeier Co., Switzerland). A 5 cm band of insecticide was applied to the base of the foundation, along the edges of doors and windows, around utility line points of entry, and along the underside edge of the eaves.

(2) A spot treatment with 3.8 liters of Termidor (0.06% fipronil) applied as a fan spray with a backpack sprayer. Only active ant trails were treated including any that were found on the house or in the yard.

(3) A perimeter and spot treatment using 11.4 liters of Talstar One (0.06% bifenthrin, FMC Corp., Philadelphia, PA) applied as a fan spray with a backpack sprayer. The perimeter spray was applied 30 cm up and 30 cm out from the foundation. The spot spray was applied along the edges of the sidewalks, and driveway, and any other area where ants were found trailing.

(4+5) An experimental sweetened liquid bait containing thiamethoxam (Syngenta Corp.) formulated at two different concentrations (0.001% and 0.003%). The KM AntPro liquid bait dispenser (KM AntPro, Nokomis, FL) was used for bait delivery (300 ml of 0.001% and 90 ml of 0.003% thiamethoxam per station). Depending on the size of the home, three to five stations were placed equidistant from one another around the exterior foundation.

Cost Analysis

A nine month cost comparison was made between a baiting program and a traditional industry treatment. Twelve homes were included in the analysis: six that were treated with bait, and six that received the traditional treatment. In the baiting program, the KM AntPro liquid bait dispenser was used to deliver 473 ml of Vitis (0.001% imidacloprid, Bayer Corpora-

tion) per station. Depending on the size of the house, four to six stations were placed around the outside perimeter and in the yard. In the traditional treatment, two separate applications using a backpack sprayer was used to apply 7.6 liters of Termidor (0.06% fipronil) as a perimeter and spot spray around the outside of each home, and 0.9 kg of Talstar G were broadcasted in foliage outside the spray zone. Two other applications were made using a backpack sprayer to apply 8.5 liters of CyKick CS (0.25% cypermethrin) to turf, hardscape, and ant trails away from the structure. Cypermethrin was not applied in areas where previous fipronil applications had been made. The time it took to make each of these applications was recorded along with the amount of material used.

Statistical Analysis

A Wilcoxon-Signed Rank Test ($P<0.05$) (Systat 2007) was used to analyze for differences between pre- and post-treatment ant numbers. The number of ants visiting each vial before treatment was compared with counts at the same vial after treatment.

RESULTS AND DISCUSSION

All treatments achieved significant reductions of ant numbers, however, the level of control varied (see Table 1). Least effective was treatment 3 (bifenthrin perimeter + spot spray), which reduced ant numbers after 8 wks by only 54% near the house and no reduction in the yard. In a previous study this same treatment provided somewhat better control at 8 wks with 71% reduction near the house and 24% reduction in the yard, and this result despite the higher pre-treatment ant numbers relative to the current study (Klotz *et al*. 2008). When compared with similar treatments using fipronil, the bifenthrin treatment is about 10 to 20% less effective, probably due to the fast-acting contact activity and minimal to no horizontal transfer of the active ingredient (Soeprono and Rust 2004a,b). As more PMPs convert their residential routes to every other month service, the treatments will need to be able to control ants for at least 8 wks.

The other treatments resulted in approximately 80% reduction of ants near the house after 8 wks, but with varying degrees of control in the yard. Most effective in the yard was the liquid bait with 0.003% thiamethoxam, which reduced the ant numbers by 80% after 8 wks. The other treatments provided

Table 1. The average performance of five different treatments for Argentine ants around homes in Riverside, CA (N = 5 homes/treatment). Residences treated in July 2008. Untreated controls (#6) are shown for comparison.

Treatment, %AI[a]	Avg. ant visits per tube before	Monitoring Site[a]	Avg. ant visits per tube (% reduction) at week after treatment[b]			
			1	2	4	8
(1) Perimeter, 0.06 fipronil pin-stream	22,281	Near	2,832 (87)***	3,357 (85)***	1,984 (91)***	4,372 (80)***
	23,861	Away	16,016 (33)**	10,929 (54)***	9,945 (58)***	17,962 (25)
(2) Spot, 0.06 fipronil	22,468	Near	4,439 (80)***	1,541 (93)***	3,100 (86)***	4,144 (82)***
	26,019	Away	9,286 (64)***	10,508 (60)***	11,325 (57)***	11,721 (55)***
(3) Perimeter, 0.06 bifenthrin + Spot	21,209	Near	2,404 (87)***	6,263 (70)***	7,269 (66)***	10,732 (54)***
	24,221	Away	9,896 (59)***	18,124 (25)*	13,909 (43)***	30,417 (0)
(4) Bait, 0.001 thiamethoxam	28,338	Near	6,131 (78)***	12,225 (57)***	3,879 (86)***	5,308 (81)***
	26,183	Away	12,647 (52)***	20,231 (5)	14,076 (46)**	11,185 (57)***
(5) Bait, 0.003 thiamethoxam	27,751	Near	8,766 (68)***	8,184 (71)***	9,640 (65)***	4,423 (84)***
	31,414	Away	18,941 (40)***	15,347 (51)***	16,649 (47)***	6,604 (80)***
(6) Untreated[c]	5,827	Near	4,494 (23)	5,469 (6)	5,711 (2)	---
	5,301	Away	4218 (20)	4,336 (18)	4,337 (18)	---

[a]Each residence monitored with 10 conical vials containing 13 ml 25% sucrose near the structure and away from the structure.
[b]Percent reductions adjusted for missing or spilled vials; Wilcoxon-Signed Rank Test, * = P<0.05, ** = P<0.01, *** = P<0.001;
[c]Due to sporadic feeding at monitoring sites and low number of ants, a Wilcoxon-Signed Rank Test was not performed on controls; ---, indicates no monitoring on this date.

only marginal (54% and 57% reductions with the fipronil spot treatment, and 0.001% thiamethoxam bait, respectively) to little control (24% with the pin-stream perimeter treatment) in the yard.

The most effective treatment overall was the 0.003% thiamethoxam bait (84% and 80% reductions near the house and in the yard, respectively). Given

the ultra-low dose of active ingredient plus its point source application, achieving this level of control represents a significant breakthrough in controlling Argentine ants with liquid baits. In previous bait trials with Gourmet (1% borate) and Vitis (0.001% imidacloprid), the levels of control were lower both near the house and in the yard: reductions of 73% and 66% with Gourmet and 83% and 64% with Vitis, respectively (Klotz *et al*. 2007, 2008).

Remarkably, the bait efficacy reported here is comparable to a Termidor treatment. Nevertheless, the cost of a baiting program (Table 2) presents a serious drawback to its incorporation into commercial pest control programs. In order to offset the additional costs, a company would need to charge 40% more than a traditional treatment program (Table 2), which would be prohibitively high for all but a few customers to afford.

It should be noted that initial setup costs for Vitis baiting were higher than expected due to the thorough inspection and mapping of each property. These additional costs would likely be reduced as the PMP gains more experience with the baiting program, resulting in about a 20% decrease in costs. Furthermore, the frequency of service for the two treatments was different. The traditional treatment was performed on a quarterly basis and the baiting on an as needed basis due to the ants consuming the bait. Future advances in baiting technology and application techniques may reduce costs. Growing environmental concerns about broadcast applications of insecticides and increasing regulations on urban water runoff could make baiting a more competitive and attractive option in future marketplaces.

The treatments with low volumes of fipronil demonstrate the efficacy of targeted sprays. The spot spray on active ant trails is a limited application but it probably maximizes horizontal transfer, resulting in reductions of 82% near the house and 55% in the yard. The pin-stream application around the foundation and at various points on the structure resulted in an 80% reduction of ants near the house. In both cases, the insecticide is placed strategically in order to maximize efficacy, minimize waste, and reduce the amount of insecticide applied. Another potential advantage of strategic applications is reduction of pesticide runoff by irrigation and rain events.

Years ago, crack and crevice treatments became the industry standard for interior treatments in structural pest control replacing baseboard spraying

Table 2. Cost analysis comparing a "traditional" ant treatment consisting of applications of fipronil, bifenthrin granules, and micro-encapsulated cypermethrin with a baiting program using sweetened liquid baits containing imidacloprid in KM AntPro bait stations.

		Cost over time (days) comparing both treatment methods[c]					
Treatment, %AI[a]	Callbacks[b]	30	31-90	91-180	181-270	Total Cost	
Traditional; 0.06 fipronil 0.2 bifenthrin granules, 0.005 cypermethrin	0	$122.70	$93.60	$93.60	$93.60	$403.50	
Liquid ant bait; 0.001 imidacloprid	3		$243.20	$164.31	$125.13	$141.60	$674.24

[a]Traditional treatments were performed using a 15-l Birchmeier backpack sprayer, 189.2 liter power sprayer, and granular spreader on a quarterly frequency. Liquid bait treatments were performed using KM AntPro liquid ant bait stations on a frequency dictated by bait consumption. Six sites were evaluated and averaged.
[b]Callbacks are defined as the client initiating a request for service when ants have gained access to the interior of the structure. Six sites were evaluated and averaged.
[c]Initial service included an inspection of the property. Traditional treatments were more encompassing and more areas on the property were treated. Liquid Bait Treatments included determining initial bait station locations and area mapping of the property using GoogleEarth maps.

with a more strategic placement of insecticides. Using a similar approach on exterior treatments can also provide the added benefits of both efficacy and reduced environmental impact.

ACKNOWLEDGMENTS

We thank the California Structural Pest Control Board (Department of Consumer Affairs) and the California Department of Pesticide Regulation for funding this research, as well as the various manufacturers that supplied the pest control products that we tested in this study. We also thank Ms. Jody Venturina, Clinton Allison, Christine Toledo, and Patrick Mullens for their help in monitoring and data collection.

REFERENCES

Choe, D.H., and M.K. Rust. 2008. Horizontal transfer of insecticides in laboratory colonies of the Argentine ant (Hymenoptera: Formicidae). J. Econ. Entomol. 101: 1397-1405.

Field, H.C., W.E. Evans, R. Hartley, L.D. Hansen, and J.H. Klotz. 2007. A survey of the structural ant pests in the southwestern U.S.A. (Hymenoptera: Formicidae). Sociobiology 49: 1-14.

Klotz, J.H., M.K. Rust, L. Greenberg, H.C. Field, and K. Kupfer. 2007. An evaluation of several urban pest management strategies to control Argentine ants (Hymenoptera: Formicidae). Sociobiology 50: 391-398.

Klotz, J.H., M.K. Rust, L. Greenberg, H.C. Field, and K. Kupfer. 2008. Controlling Argentine ants in residential settings (Hymenoptera: Formicidae). Sociobiology 51: 579-588.

Knight, R.L., and M.K. Rust. 1990. The urban ants of California with distribution notes of imported species. Southwest. Entomol. 15: 167-178.

Reierson, D.A., M.K. Rust, and J. Hampton-Beesley. 1998. Monitoring with sugar water to determine the efficacy of treatments to control Argentine ants, *Linepithema humile* (Mayr), pp. 78-82. In Proceedings of the National Conference on Urban Entomology, 1998, San Diego, California, 127 pp.

Soeprono, A.M., and M.K. Rust. 2004a. Effect of horizontal transfer of barrier insecticides to control Argentine ants (Hymenoptera: Formicidae). J. Econ. Entomol. 97: 1675-1681.

Soeprono, A.M., and M.K. Rust 2004b. Effect of delayed toxicity of chemical barriers to control Argentine ants (Hymenoptera: Formicidae). J. Econ. Entomol. 97: 2021-2028.

Systat Software, Inc. 2007. Version 12. Statistics III. San Jose, CA.