Developing Low Risk Management Strategies for Argentine Ants (Hymenoptera: Formicidae)

by

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ABSTRACT

Perimeter treatments with Termidor® were evaluated for efficacy in reducing outdoor infestations of Argentine ants around homes in southern California. Treatments were applied according to the amended Termidor® label restrictions, accepted by the California Department of Pesticide Regulation in 2009, limiting applications to the structure and not more than one foot away. The two variables of interest in this study were (1) volume of insecticide applied (either 1 or 0.5 gallons), and (2) nozzle setting on a compressed air sprayer (either for a fan spray or pin-stream application). These two variables were chosen with the goal of reducing the amount of insecticide applied and mitigating insecticide runoff. Most effective was the one gallon pin-stream application: an 85% reduction of ants near the house, and 63% reduction in the yard, 6 wks after treatment. In comparison, the one gallon fan spray application was much less effective over the same time period: 46% reduction near the house and 29% reduction in the yard. Even less effective was the 0.5 gallon pin-stream application, which did not result in sufficient reductions of ants. The 0.5 gallon fan spray, however, provided 60% reduction of ants near the house two months after treatment but no reduction in the yard. A combination treatment of a perimeter application of Termidor® with granular metaflumizone bait broadcasted outside the spray zone provided the greatest ant reduction (86%).

Key Words: Argentine ants, ant control, fipronil, metaflumizone

INTRODUCTION

The Argentine ant, *Linepithema humile* (Mayr), is listed on the Global Invasive Species Database as one of the world's worst invasive species (Lowe *et al.* 2000). In the US, it has spread through most of the southeastern states,

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subsequent to its putative introduction into the Port of New Orleans in the late 1800s (Newell & Barber 1913). However, Argentine ant distribution in the Southeast is sporadic and infestations have well-defined boundaries such as a neighborhood, business park, or college campus (Silverman & Brightwell 2008). In contrast, in California where Argentine ants are the number one urban pest, their infestations can extend over entire habitats and populations may reach astronomical numbers (Vega & Rust 2001). In Riverside, for example, more than a half million ant visits to bait stations placed around homes were recorded over a 24-hour period (Reierson *et al.* 1998).

To control outdoor infestations of this magnitude, the structural pest control industry has relied over the years on various pyrethroid insecticides that are applied as perimeter sprays and granules around homes. Although perimeter treatments have been the traditional approach in commercial pest control, satisfactory barriers are difficult to achieve because of irrigation, dense groundcover, mulch, and chemical degradation due to high temperature, substrate alkalinity, and direct sunlight, which all compromise efficacy (Rust *et al.* 1996). With the registration of fipronil, however, these factors are of less concern because of its potency and horizontal transfer, particularly when it is applied directly to the ants (Soeprono & Rust 2004a,b; Choe & Rust 2008).

Consequently, the sales of fipronil (a non-pyrethroid insecticide) have dramatically increased in California from 1,900 lbs active ingredient (AI) in 2000 to 24,000 lbs AI in 2006, with most being attributed to ant treatments (TDC 2008). Unfortunately, this insecticide has been detected in our urban waterways (Hladik & Orlando 2008), necessitating major changes in pesticide use patterns by the structural pest control industry. Early in 2009, the California Department of Pesticide Regulation accepted an amended Termidor® label restricting its application to the structure and not more than one foot away (= perimeter spray treatment). Prior to this label change, Termidor® had been applied to ant trails out in the landscape away from the structure. Our research showed that spot treating these trails with one gallon of Termidor® spray was as effective as a general treatment of the property using three to four gallons of spray (Klotz *et al.* 2007, 2009). However, in one case the spot treatment was less effective than the general treatment (Klotz *et al.* 2008).

In three previous publications in Sociobiology (Klotz *et al.* 2007, 2008, 2009) we reported on the efficacy of various experimental and commercial treatment strategies for Argentine ant infestations around homes. A number of these strategies were designed to reduce the amount of insecticide applied as well as mitigate insecticide runoff. The treatments most effective in reducing ant activity were directed sprays with Termidor® (fipronil) and sweetened liquid baits containing thiamethoxam.

Given the new label restrictions on Termidor®, our objective in this study was to evaluate efficacy of this more limited application focusing on two variables: (1) the volume of insecticide applied (either 0.5 or 1.0 gallon), and (2) the method of delivery (either as a fan spray or pin-stream application). In addition, we evaluated the efficacy of a combination treatment consisting of a perimeter spray of Termidor® with an experimental granular bait containing metaflumizone, which was broadcasted outside the spray zone.

MATERIALS AND METHODS

Homes located in Riverside, California, with outdoor infestations of Argentine ants were monitored both before and after treatment (5 houses per treatment) to determine the percent reduction of ants at 1,2,4,6, and 8 weeks after treatment. Estimates of ant numbers were based on their consumption of sucrose water (25%) over a 24-h monitoring period. The experimental design and monitoring procedure were the same as used in three previous studies (for a more detailed description see Klotz *et al.* 2007, 2008, 2009).

In the first series of treatments, perimeter applications of Termidor® SC (0.06% fipronil, BASF, Greensboro, NC) were made using a 15-liter backpack sprayer (Birchmeier Co., Switzerland) and varied according to the volume of insecticide applied (either 0.5 or 1.0 gal.) and setting of the aperture on the sprayer nozzle (either for a fan spray or pin-stream application). The coarse fan spray was applied 30 cm up and 30 cm out from the foundation, while the pin-stream consisted of a 5-cm band of insecticide applied at the base of the foundation. Each treatment was repeated at five homes. Five untreated control sites were also included and monitored along with the treated homes. Ant numbers around homes were monitored using vials of sucrose water (13ml/vial), 10 placed equidistant from one another around the exterior foundation (near), and 10 placed out in the yard about 5 m from the house (away).

In a second series of treatments, we evaluated a combination treatment consisting of Termidor® applied as a perimeter spray plus an experimental toxic granulated bait (0.063% metaflumizone) broadcasted in the yard outside the spray zone. The three treatments in this series included a: (1) perimeter treatment with 0.5 gal. Termidor® SC (0.06% fipronil) applied as a fan spray 30 cm up and 30 cm out from the foundation; (2) toxic bait broadcasted at 10.4 g / 100 ft^2; and (3) combination treatment with (1) and (2). Each treatment was repeated at four homes. Untreated control sites were not included in this series, and monitoring was conducted with 10 vials near the homes.

Statistical Analysis

A Wilcoxon-Signed Ranks 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

Table 1 summarizes the results of the first series of treatments which consisted of perimeter applications of Termidor® that were varied according to the volume applied and the nozzle aperture setting on the backpack sprayer. Most effective was the pin-stream application using 1 gal. of Termidor®: an 85% reduction of ants around the house (near), and 63% reduction of ants out in the yard (away), 6 wks after treatment. Less effective was the fan spray application using 1 gal. of Termidor®: a 46% reduction around the house (near), and 29% reduction in the yard, 6 wks after treatment. The 0.5 gallon fan spray was more effective around the house (near) than the one gallon fan spray, resulting in a 60% reduction of ants after 8 wks; however, there was little to no reduction of ants out in the yard (away) throughout the 8 wk duration of the test. The 0.5 gallon pin-stream application was much less effective than the 1 gal. pin-stream application with only 26% reduction near the house and no reduction in the yard 6 wks after treatment.

The second series of treatments that included baits (Table 2), achieved an 80% reduction of ants after two months in the homes that were treated with Termidor® alone, and an 86% reduction in homes treated with Termidor® + bait. Homes treated with the bait alone had only a 69% reduction in ants.

Compared to the first series, the higher reduction in ant numbers at 8 wks with the fipronil sprays was probably attributed to the limited amount of yard around each of the homes in this treatment series. These homes had less than 10 ft of yard between structures and only a small backyard (about 300-400 ft^2), increasing the likelihood that foraging ants would encounter the treated band. The small yards also reduced the amount of untreated refuge and source for re-invasion.

Overall, these more limited Termidor® treatments that were restricted to the structure were significantly less effective than our treatments in previous years when the label in CA allowed applications out in the landscape. Due to horizontal transfer, the efficacy of fipronil is maximized when trailing ants are treated. Since most of the foraging activity of Argentine ants is concentrated along walkways, driveways,

Table 1. Efficacy as measured by Argentine ant reductions of various perimeter applications of Termidor around homes in Riverside, CA (N = 5 homes/treatment). Residences treated in July, 2009.

Treatment, % AI[a] Nozzle setting, volume	Avg. ant visits per vial before	Monitoring Site[a]	Avg. ant visits per vial (% reduction) at week after treatment[b] 1	2	4	6	8
(1) Perimeter, 0.06 fipronil	8,275	Near	3,330 (60)**	5,721 (31)*	853 (90)***	1,218 (85)***	8,852 (0)ns
Pin-stream, 1 gal.	21,981	Away	15,946 (27)**	29,873 (0)**	18,560 (16)ns	8,142 (63)***	30,073 (0)*
(2) Perimeter, 0.06 fipronil	3,783	Near	1,181 (69)***	3,043 (20)**	2,383 (37)*	2,031 (46)*	7,458 (0)ns
Fan spray, 1 gal.	10,351	Away	9,548 (8)ns	17,028 (0)ns	11,798 (0)ns	7,327 (29)*	18,551 (0)ns
(3) Perimeter, 0.06 fipronil	21,176	Near	9,527 (55)**	11,427 (46)***	13,151 (38)**	15,707 (26)ns	30,169 (0)**
Pin-stream, 0.5 gal.	29,398	Away	28,712 (2)ns	32,259 (0)*	29,556 (0)ns	31,662 (0)ns	39,955 (0)***
(4) Perimeter, 0.06 fipronil	9,881	Near	6,757 (32)ns	2,907 (71)***	3,873 (61)**	9,785 (1)ns	4,028 (60)*
Fan spray, 0.5 gal	13,433	Away	18,022 (0)ns	14,109 (0)ns	13,229 (2)ns	14,987 (0)ns	13,915 (0)ns
(5) Untreated	8,005	Near	4,327 (46)ns	17,983 (0)*	15,501 (0)ns	9,829 (0)ns	42,266 (0)***
	7,237	Away	12,147 (0)ns	18,871 (0)ns	7,711 (0)ns	13,535 (0)ns	22,874 (0)ns

[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, ns = nonsignificant.

street curbs, garden edges, and up into the trees and shrubs, control suffers when these areas are not treated. One possible alternative with minimal potential for insecticide runoff would be to use baits in these areas with high ant activity. The results of the experimental baiting program with metaflumizone were encouraging in this respect.

Table 2. Average performance of three different treatments to control Argentine ants around homes in Riverside, CA (N = 4 homes/treatment). Residences treated in August, 2009.

Treatment, % AI[a]	Avg. ant visits per vial before	Avg. ant visits per vial (% reduction) at week after treatment[b]				
		1	2	4	6	8
(1) Perimeter, 0.06 fipronil Fan spray, 0.5 gal.	20,232	674 (97)***	2,959 (85)***	5,016 (75)***	7,344 (64)***	4,004 (80)***
(2) Bait, 0.063 metaflumizone broadcasted 1.5 lb./acre	12,502	904 (93)***	3,000 (76)***	3,070 (75)***	3,706 (70)**	3,887 (69)**
(3) Perimeter, 0.06 fipronil Fan using 0.5 gal. + Bait, 0.063 metaflumizone	16,806	1,395 (92)***	3,110 (81)***	3,043 (82)***	2,586 (85)***	2,423 (86)***

[a]Each residence monitored with 10 conical vials containing 13 ml 25% sucrose placed around the structure.
[b]Percent reductions adjusted for missing or spilled vials; Wilcoxon-Signed Rank Test, * = P<0.05, ** = P<0.01, *** = P<0.001

The superior performance of the one-gallon pin-stream application of Termidor® relative to the fan spray applications may be due to the highly concentrated band of insecticide in combination with the Argentine ants' tendency to trail along the treated edge of the foundation. This should maximize the pick up and transfer of fipronil between workers. Besides being more effective, alternative application techniques such as this, are more target-specific, and may greatly reduce the risk of pesticide runoff.

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