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Developing Low Risk Management Strategies for Argentine Ants

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INTRODUCTION

This two-year study examined the impact of various treatment strategies on ant control and insecticide runoff. Treatments were applied in the summer months of 2008 and 2009 at homes in Riverside, CA, to assess percent reduction of ants. Water runoff from these treated homes was also collected periodically and the samples submitted for insecticide analysis.

METHODS

Efficacy studies

The results were based on estimates of ant numbers before and after treatment as to the percent reduction in ant numbers from pre-treatment levels. The monitoring procedure to estimate ant numbers was based on consumption of sucrose water. Ten vials of sucrose water were placed around the outside perimeter of each house and 10 more were placed in the yard. The vials were left in place for 24 hours and then collected to measure consumption. We have determined that on average an Argentine ant consumes 0.3 mg of sucrose water per visit, so this figure along with total consumption is used to calculate the average number of ant visits per vial before and after treatment. Untreated control sites were also included and monitored along with the treated homes.

2008

Six different spray treatments were evaluated including three with Termidor (0.06% fipronil) and three with Talstar (0.06% bifenthrin):

Termidor treatments:

(1) Perimeter spray treatment with 1 gal. 0.06% fipronil (Termidor SC) applied with a 5-gallon backpack sprayer with a pin stream nozzle that applies a narrow 2-in band along the foundation and not more than 1 ft away from the foundation, excluding the driveway. (5 homes, 3 sampled for pesticide runoff).
(2) Spot treatment with 1 gal. 0.06% fipronil (Termidor SC) applied with a backpack sprayer to active ant trails around the outside perimeter of the house and in the yard. (5 homes, 3 sampled for pesticide runoff). No spray on driveway.
(3) Spot treatment with 1 gal. 0.06% fipronil (Termidor SC) applied with a backpack sprayer to active ant trails around the outside perimeter of the house and in the yard, but not within 15 ft of the street and 5 ft of sidewalks and the driveway (no-spray zones). (5 homes, 3 sampled for pesticide runoff).

Talstar treatments:

(4) Perimeter treatment of the house foundation with 3 gals 0.06% bifenthrin (Talstar F) applied with a backpack sprayer with a traditional fan nozzle, and spot treatments to active trails and nests in the yard. (5 homes, 3 sampled for pesticide runoff).
(5) Perimeter treatment of the house foundation with 3 gals 0.06% bifenthrin (Talstar F) applied with a backpack sprayer with a pin stream nozzle that applies a narrow 2-in band, and spot treatments of active trails and nests in the yard, but not within 15 ft of the street and 5 ft of sidewalks and the driveway (no-spray zones). (5 homes, 3 sampled for pesticide runoff).
(6) Spot treatment with 3 gals 0.06% bifenthrin (Talstar F) applied with a backpack sprayer to active ant trails around the outside perimeter of the house and in the yard, but not within 15 ft of the street and 5 ft of sidewalks and the driveway (no-spray zones) (5 homes, 3 sampled for pesticide runoff).

2009
Two different series of treatments were applied:

Series I. Perimeter applications of Termidor SC (0.06% fipronil) were made using a 15-liter backpack sprayer 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.

Series II. 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) a 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 only 10 vials near the homes.

Runoff studies
2008
Samples were collected at three homes from each of the six treatments in the efficacy studies. To facilitate the collection of water samples, homes located on slopes were monitored and homeowners were requested to irrigate at a time convenient for sampling. The collection of runoff from each home was made at the curbside as soon as the water began to run in the street. A Styrofoam dam cut into a U-shape was placed where the water was running in the street and three small sandbags were placed on top to anchor it in place and form a tight seal with the cement (Fig. 1). A 1 liter water sample was collected from the pooled water in the center of the dam using a 60-ml glass aquatic pipette and then transferred to a clean amber glass collection bottle and returned to the laboratory. The samples were refrigerated until analysis following EPA recommended procedures. Water samples were collected 1, 7, and 14 days post-treatment. The 14 day sample consisted of runoff from a 15-min flush of the driveway.

2009
Water samples were collected from 5 houses of each of the 4 treatments described in **Series I** above. The same water collection procedure used during 2008 was repeated. Samples were collected 1, 7, 21, and 56 days post-treatment. The 56-day water collection differed in that it consisted of a 40-gal thorough flush of the building's sprayed foundation and driveway. The purpose of this last sample was to see whether residual insecticide could still be found on the building or driveway.

RESULTS AND CONCLUSIONS

Efficacy Studies
Table 1 summarizes the results of the efficacy studies for each of the six different treatments in 2008. Tables 2 and 3 summarize the results of the efficacy studies for each of the two series of treatments applied in 2009.

2008
Acceptable levels of ant control were not achieved in any of the treatments that included a no-spray zone (treatments #3, 5, and 6 in Table 1). As a possible remedy to this situation, future studies will investigate bait applications in the no-spray zones. Most effective was the spot treatment with one gallon of Termidor (treatment #2, Table 1) applied as a fan spray to active ant trails. There was an 82% reduction of Argentine ants near the structure, and 55% reduction away from the structure in the yard. The pin-stream application using one gallon of Termidor around the outside perimeter (treatment #1, Table 1) reduced the ants near the house by 80% after eight weeks. Much less control was achieved away from the house, out in the yard (25% reduction). The Talstar treatment with three gallons applied around the perimeter of the house and along the edges of the sidewalks and driveway (treatment #4, Table 1) reduced the ant numbers by 54% near the house after eight weeks; however, no reduction in ants was achieved away from the house.

2009
Table 2 summarizes the results of the first series of treatments in 2009, 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 (treatment #1, Table 2): 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 (Treatment #2, Table 2): a 46% reduction around the house (near), and 29% reduction in the yard, 6 wks after treatment. The 0.5 gallon fan spray (Treatment #4, Table 2) 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 (Treatment #3, Table 2) 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 3), achieved an 80% reduction of ants after two months in the homes that were treated with Termidor alone (Treatment #1, Table 3), and an 86% reduction in homes treated with Termidor + bait (Treatment #3, Table 3). Homes treated with the bait alone (Treatment #2, Table 3) had only a 69% reduction in ants. The higher reduction in ant numbers at 8 wks with the fipronil sprays compared to results in Series I (Table 2) was probably due to the limited amount of yard around each of the homes in the Series II treatments. 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.

The superior performance of the one-gallon pin-stream application of Termidor relative to the fan spray applications in 2009 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 behavior should maximize the pick up and transfer of fipronil between workers.

Insecticide Runoff 2008

The lowest runoff was achieved using a pin stream application that was restricted to the house foundation (Fig. 2). Intermediate in runoff was the fan spray that included a no-spray zone. The highest runoff was from a fan spot treatment, which included treatments around the driveway and sidewalk. The LD_{50} for *Ceriodaphnia*, an aquatic organism used in water quality evaluations, is 10 parts per billion (ppb). One of the houses with the spot treatment exceeded this value, while none of the houses receiving the pin stream treatment exceeded the LD_{50}. A general conclusion for 2008 was that a pin stream application of fipronil limited to the house foundation gave good efficacy (Table 1, treatment 1, 80% reduction after 8 weeks) and also had a very low runoff of the insecticide (mean of 0.08 ppb).

On the other hand, fan perimeter treatments with bifenthrin resulted in insecticide runoff that greatly exceeded the bifenthrin LD_{50} for *Ceriodaphnia* (0.078 ppb) at all sample dates (Fig. 3). The pin stream perimeter application of bifenthrin including a no-spray zone was below the LD_{50} on day 1, and the fan spray with a no-spray zone was intermediate. However, neither of the latter two treatments gave good efficacy (Table 1, treatments 5 and 6).

Insecticide Runoff 2009

During 2009 all treatments were restricted to the house foundation and consisted of either fan or pin stream applications of 1 or 0.5 gal of fipronil. Fig. 4 shows the insecticide runoff from these treatments. Besides *Ceriodaphnia*, the figure also shows a horizontal line representing the LD_{50} (0.14 ppb) of another aquatic invertebrate, Mysid shrimp, which are even more sensitive to fipronil. At day 1 the runoff from all the treatments are well below the LD_{50}s for both species. At day 56 all the lines show a sharp increase in runoff after the 40-gal water flush. Some of these values are now above the Mysid shrimp LD_{50} line and are getting close to the line for *Ceriodaphnia*. Therefore, although very

little insecticide is running off due to irrigation with these treatments limited to the house foundation, there is still potential for significant runoff during the rainy season.

Table 1. The average performance of six different treatments for Argentine ants around homes in Riverside, CA (N = 5 homes/treatment). Residences treated in July 2008.

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	22,281	Near	2,832 (87)	3,357 (85)	1,984 (91)	4,372 (80)
Pin-stream	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) Spot, 0.06 fipronil	19,056	Near	12,440 (35)	7,694 (60)	15,289 (20)	14,622 (8)
With no spray zone	33,202	Away	15,282 (54)	14,631 (56)	18,669 (44)	23,316 (31)
(4) Perimeter, 0.06 bifenthrin	21,209	Near	2,404 (87)	6,263 (70)	7,269 (66)	10,732 (54)
+ Spot	24,221	Away	9,896 (59)	18,124 (25)	13,909 (43)	30,417 (0)
(5) Perimeter, 0.06 bifenthrin	21,822	Near	5,300 (76)	12,362 (43)	13,686 (37)	16,065 (26)
Pin-stream with no spray zone	27,500	Away	12,957 (53)	15,315 (44)	22,181 (19)	22,801 (17)
(6) Spot, 0.06 bifenthrin	26,031	Near	7,721 (70)	9,639 (64)	13,517 (48)	22,846 (13)
With no spray zone	22,737	Away	7,708 (66)	18,861 (52)	14,194 (38)	15,628 (29)

[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; ----, indicates no away or near sites.

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

[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.

Table 3. 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.

Figure 1. Collecting a water sample from lawn irrigation runoff at a house that had received an insecticide treatment for Argentine ants.

Figure 2. Geometric means of log (X + 1) transformed data of fipronil concentrations (parts per trillion) in runoff water after different treatments during 2008. The day 14 results are from a driveway flush instead of irrigation water runoff. The y-axis shows parts per billion (+1)

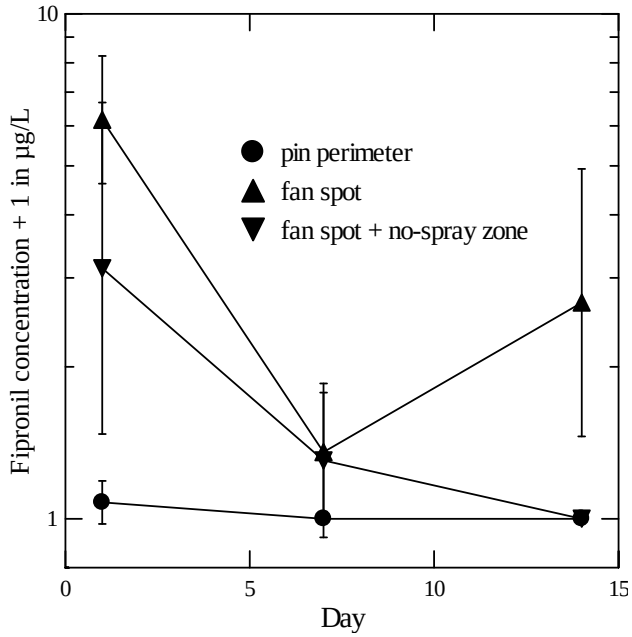

Figure 3. Geometric means of log (X + 1) transformed data of bifenthrin concentrations (parts per trillion) in runoff water after different treatments during 2008. The day 14 results are from a driveway flush instead of irrigation water runoff. The y-axis shows parts per billion (+1)

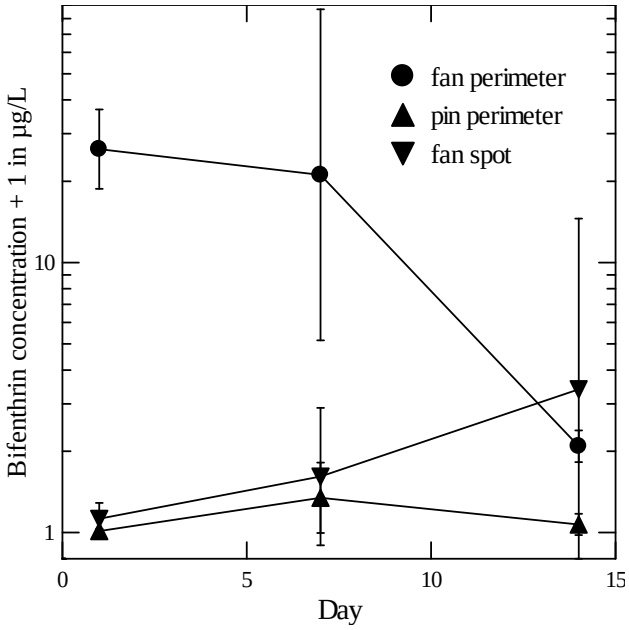

Figure 4. Geometric means of log (X + 1) transformed data of fipronil concentrations (parts per trillion) in runoff water after different treatments during 2009. The y-axis shows parts per trillion (+1)