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Ant Behavior Impacts Barrier Efficacy


Ant monitoring sugar vials were used throughout the test sites.

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Contributors

Knowing Argentine ants' foraging patterns can make all the difference.

The Argentine ant, *Linepithema humile* or *Iridomyrmex humilis* (Mayr), is ranked first among insect pests found in urban environments in North America (Holway 1999). Knight and Rust (1990) describe this ant as the most widespread insect pest in populated areas of California.

Argentine ant foragers are most abundant between the months of May and November, but can be found throughout the year in the San Francisco Bay area. Their colonies are polygynous (multiple queens) and largely interconnected (polydomous) with no hostility between adjacent colonies. Foraging by Argentine ants is temperature-dependent, as well as seasonal. Ants will not forage under extremes of hot or cold and are influenced by weather patterns. Rust and Hooper (1998) showed that Argentine ants forage preferentially on proteins or carbohydrates, depending on the time of year. This behavior is related to brood production and also fluctuates seasonally.

Barrier Efficacy

These factors make Argentine ant management difficult. The objective of this study was to evaluate the efficacy of a chemical barrier around structures to manage infestations.

Materials and Methods

One commercial and eight residential sites were selected for study (Tables one and two). All structures had a previous history of Argentine ant invasions. Existing colonies were located through visual inspection. Outside perimeter distance for each building perimeter was determined using a distance measuring wheel.

Residential Sites	Perimeter Distance ft[b]	Treatment[c]	Gallons Used[d]
Dublin 1	220	Water Replicate	5
Dublin 2	350	0.50%	8.75
Antioch	200	0.25%	5
Livermore	220	0.25%	5
San Ramon 1	204	0.50%	5
San Ramon 2	210	0.125%	5
Berkeley	192	Water Replicate	5
Oakland	271	Water Replicate	7

[a] Sites were single-family residences with landscaped yards and exterior wooden decks.
[b] Perimeter distance was determined using a distance measuring wheel (Model RR-318, Keson Industries, Napperville, Ill.).
[c] Chlorfenapyr 2SC (21.44 percent) liquid concentrate was provided by BASF Corp., Research Triangle Park, N.C.
[d] All treatments were applied by hand-pressurized backpack sprayers (four-gallon capacity, Model 425, Solo, Inc, Newport News, Va).

▲ *Table one. Residential sites, perimeter distance, treatment and gallons used during the chemical barrier efficacy study[a].*

Buildings	Perimeter Distance ft[b]	Treatment[c]	Gallons Used[d]
FPL-470	91	0.50%	2.5
FPL-471	102	0.125%	2.5
FPL-472	188	0.125%	5
FPL-473	342	0.25%	9
FPL-475	88	0.125%	2
FPL-476	120	0.50%	3

[a] The commercial site was located at the University of California, Forest Products Laboratory, Richmond, Calif.
[b] Perimeter distance was determined using a distance measuring wheel (Model RR-318, Keson Industries, Napperville, Ill.)
[c] Chlorfenapyr 2SC (21.44 percent) liquid concentrate was provided by BASF Corp., Research Triangle Park, N.C.
[d] All treatments were applied by hand-pressurized backpack sprayers (four-gallon capacity, Model 425, Solo, Inc, Newport News, Va)

▲ *Table two. Commercial buildings, perimeter distance, treatment and gallons used during the chemical barrier efficacy study[a].*

Dr. Vernard Lewis applies the barrier to a residential site.

Initial ant pressure at each location was evaluated using two different methods, including visual counts and consumption of 10 percent sugar solution. Visual ant counts consisted of three, one-minute counts taken five minutes apart on established trails moving in the direction of the nest. The mean of three counts was calculated, multiplied by 60 and then by 24 to estimate the 24-hour forager number.

The consumption estimate consisted of leaving 10 percent sugar solution vials out for foragers to find and feed. Vials containing 50 milliliters of 10 percent sugar solution were placed adjacent to established trails. The cap of each vial had a half-inch-diameter hole center-drilled through them to allow for the insertion of a half-inch-diameter dental wick. The solution-filled vials were weighed prior to installation in the field. Vials were installed around structures and left for 24 hours. Evaporative loss was also determined, using vials inaccessible to ant feeding.

All vials were then collected and reweighed to determine the amount of solution consumed by ants. The total number of ants feeding on a vial over a 24-hour period was calculated based on a feeding rate of 0.3 milligrams per ant, per visit (Reierson et. al. 1998). Visual ant counts

Sites[b]	Treatments	Pre-treatment	24-Hour Post-treatment	1-week Post-treatment	2-week Post-treatment	4-week Post-treatment	8-week Post-treatment
Dublin 1	Water Replicate	0	8640	4320	1440	1440	0
Dublin 2	0.50%	5760	14400	7200	20160	53280	5760
Antioch	0.25%	30240	0	0	0	0	20160[c]
Livermore	0.25%	17280	5760	0	0	0	27360[c]
San Ramon 1	0.50%	61920	8640	17280	61920	5760	14400
San Ramon 2	0.125%	21600	7200	1440	0	0	0[c]
Berkeley	Water Replicate	27360	37440	40320	17280	21600	7200
Oakland	Water Replicate	*	15840	125280	11520	14400	0
FPL-470	0.50%	21600	0	0	1440	0	21600
FPL-471	0.125%	25920	0	0	0	0	0
FPL-472	0.125%	74880	41760[c]	1440	14400	31680	7200
FPL-473	0.25%	57600	1440	1440	0	0	0
FPL-475	0.125%	7200	1440[c]	69120	21600	37440	59040
FPL-476	0.50%	14400	0	0	1440	0	0

[a] *Visual ant estimates consisted of three, one-minute counts taken five minutes apart on established trails moving in the direction of the nest.*
[b] *All residential sites are single-family residents with landscaped yards and exterior wooden decks. The commercial site was located at the University of California, Forest Products Laboratory, Richmond, Calif.*
[c] *Denotes live foragers seen inside the building during inspections or reported by homeowners.*
**Denotes missing data.*

▲***Table three. Estimated forager number using visual counts for residential and commercial sites treated with chlorfenapyr or water replicates[a].***

Sites[b]	Treatments	Pre-treatment	24-Hour Post-treatment	1-week Post-treatment	2-week Post-treatment	4-week Post-treatment	8-week Post-treatment
Dublin 1	Water Replicate	0	33667	0	0	190000	11000
Dublin 2	0.50%	0	64333	0	64333	220667	232333
Antioch	0.25%	806667	225333	172333	264667	418333	69333[c]
Livermore	0.25%	0	69667	26333	0	81333	54667[c]
San Ramon 1	0.50%	0	25000	72667	114000	131333	310000
San Ramon 2	0.125%	0	12333	0	106333	0	24000[c]
Berkeley	Water Replicate	*	692000	225000	179667	200667	447667
Oakland	Water Replicate	73667	*	169333	142333	211667	86000
FPL-470	0.50%	74333	0	55000	62000	0	274333
FPL-471	0.125%	112333	5167	2667	61667	0	51333
FPL-472[c]	0.125%	27667[c]	0	90667	56000	179000	548000
FPL-473	0.25%	81667	73000	0	56667	0	46000
FPL-475	0.125%	154000[c]	10333	119333	508667	865333	1096667
FPL-476	0.50%	74333	44333	0	71000	0	239333

[a] *Vials containing 50 milliliters of 10 percent sugar solution were placed adjacent to established trails for 24 hours. The total number of ants feeding from the vial over the 24-hour period was calculated based on a feeding rate of 0.3 milligrams per ant per visit.*
[b] *All residential sites are single-family residences with landscaped yards and exterior wooden decks. The commercial site was located at the University of California, Forest Products Laboratory, Richmond, Calif.*
[c] *Denotes live foragers inside the building seen during the inspections or reported by homeowners.*
**Denotes missing data.*

▲ ***Table four. Estimated forager numbers using 10 percent sugar water consumption for residential and commercial sites treated with chlorfenapyr or water replicates[a].***

and 24-hour consumption rates were recorded at day one and one, two, four and eight weeks post-treatment. The study was conducted between May 19, and July 22, 1999.

Four replicates of 0.5 percent and 0.125 percent chlorfenapyr 2SC and three replicates of 0.25 percent chlorfenapyr 2SC and water blanks were applied around structures (Tables one and two). Site and treatment replicates were all randomly selected. Concentrated chlorfenapyr 2SC (21.44 percent) was diluted to final concentrations using the following protocol provided by the manufacturer:

- 0.50 percent active ingredient (a.i.)—three ounces per gallon of water;
- 0.25 percent a.i.—1.5 ounces per gallon of water; and
- 0.125 percent a.i.—0.75 ounces per gallon of water.

Three water replicates were used as untreated controls. A single residential site was treated with water (untreated control), even though no visual counts of foragers were noted during the treatment.

All chemical treatments and water replicates were applied to building perimeters using a hand-pressurized backpack sprayer at a rate of approxi-

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An insecticidal barrier is applied to the deck of a residential site.

mately 38 feet per gallon. Gallons of dilute material varied among buildings (Tables one and two). The chemical barrier was applied around the perimeter of the structure, one foot up the exterior wall and two feet out from the foundation. Exterior decking was sprayed, as well as any landscape shrubbery within the two-foot band extending from the foundation.

Results and Discussion

Ant pressure outside buildings varied dramatically, irrespective of the monitoring method used (Tables three and four). For visual estimates, pre-treatment counts varied four orders of magnitude (zero to greater than 74,000). Consumption-based estimates of forager number were more extreme at six orders of magnitude (zero to greater than 800,000). Much of the variance in forager number was from pretreatment estimates of "zero" for Dublin and San Ramon residences. However, complaints of ants by homeowners and visual sightings of ants at 24 hours post-treatment confirmed ant presence at these residences.

Comparing monitoring methods, consumption rates produced estimates at least one order of magnitude greater than visual estimates. However, we believe these consumption estimates were unreliable. One possible reason is feeding by day-flying wasps and nocturnal rodents, although we did not observe feeding by animals other than ants during the study. The erratic movement of trails, multiple trails at the same locations and placement of vials in the same location each visit are additional factors to consider. Because of these points, we believe future studies should use feeding station designs that exclude animals other than ants, as well as allow for multiple foraging trails and trail movement.

Regarding chlorfenapyr treatments, except for one building, the rest showed a reduction in outdoor populations of foragers. Forager numbers around the outside of all structures were reduced by 74 percent for residential sites and 78 percent for commercial sites during the study. Reduction in foragers continued for most buildings, although by the eighth week, three residential buildings (Antioch, San Ramon 2 and Livermore) and two commercial buildings (FPL-472 and FPL-475) had ants foraging inside. For the commercial buildings, the failures were immediately detected 24 hours post-treatment. Most of the failures were from the lowest chlorfenapyr concentration (0.125 percent) used, but the highest concentration leaves a milky residue after drying on wood siding, redwood decking and concrete, which might limit its use on residential structures. **PC**

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