Submitted Papers
ANTS

Modifying Perimeter Sprays for Ant Control to Reduce Pesticide Runoff into Urban Waterways

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Pesticide runoff in to urban water ways has become a major problem throughout the U.S. A 10-year survey of runoff studies of urban areas in CA found that bifenthrin and fipronil were present in 69% and 19% of sediment samples and 64% and 39% of water samples, respectively (CASQA 2013). Pyrethroids were commonly found at levels lethal to sensitive aquatic organisms. Similarly, sediments from 59% of 20 urban sites in Illinois were toxic to the amphipod *Hyalella azteca* and pyrethroids were detected in 95% of the samples (Ding et al. 2010). In Texas, 66% of the 18 urban sites sampled had levels of pesticides great enough to kill aquatic organisms (Hintzen et al. 2009). This runoff has been attributed to the outdoor applications of pesticides to control ants.

The objectives of this research were to develop and evaluate low-impact treatment strategies that reduced the amount of pesticides applied and incorporated recent label directions that prohibit the treatment of impervious surfaces such as concrete and asphalt. Two different low-impact strategies were conducted by collaborating pest management professionals (PMPs). The residences were monitored to determine the efficacy of the treatments and the pesticide runoff for the entire ant season.

Methods and Materials

Estimating ant numbers. To evaluate ant populations, the numbers of ants around homes were monitored using vials containing 13 ml of 25% sucrose water (Klotz et al. 2009). Ten vials were placed on the ground around the exterior foundation (“house”), and 10 additional vials were placed out in the yard about 5 m from the structure (“yard”). The vials were then reweighed to measure the amount of sucrose water consumed by the ants. Post-treatment evaluations of ant numbers were done at 1, 2, 4, 8, 10, and 14 wks.

Treatment protocols. We collaborated with two large pest management companies. Ten homeowners, 5 for each company, volunteered their homes for these summer trials.

Protocol 1. The first company (PMP 1) scheduled bimonthly treatments (July and September). Each house was treated with an average of 1.9 L of 0.06% fipronil spray (Termidor® SC, BASF, Research Triangle Park, NC), 3.8 L of 0.1% cyfluthrin (Cy-Kick® CS, Whitmire Micro-Gen, St. Louis, MO), and 409 g of 0.2% bifenthrin granules

(Talstar® PL, FMC, Philadelphia, PA). In July, the fipronil spray was applied with a Birchmeier Flox 10 L backpack sprayer with an adjustable cone nozzle. It was applied as a narrow band approx. 5.1 cm up and 5.1 cm out from the house foundation at the grade/wall junction. At the garage door/driveway interface (but not specifically into the expansion joint) the spray was applied as a pin stream with the applicator tip held about 0.6 m away from the surface. PMP 1 supplemented the fipronil spray with bifenthrin granules applied with a 14 oz CentroBulb Duster around landscaped areas such as bushes and trees and decorative walls and borders. Any granules that landed on impervious surfaces (driveway and walks) were swept to nearby soil or grass. On day 63 the granular bifenthrin was applied as described above and a 20 cm band of cyfluthrin spray was also around the house foundation, except for the driveway or other impervious surfaces in the backyard. A pin stream of cyfluthrin was applied to the driveway at the garage door, as well as the edges of the lawn next to the driveway.

Protocol 2. The company (PMP 2) scheduled monthly home service from July through October. Each house was treated with an average of 1.9 L 0.06% fipronil, 2.3 L of 0.1% cyfluthrin, and 11.3 L of a botanical pesticide, 0.025% EcoPCO® WP-X WP (Prentiss Inc., Alpharetta, GA). Using a B&G handheld tank sprayer and adjustable cone tip they sprayed the fipronil band 30 cm up and 30 cm out from the grade/wall junction. At the garage door/driveway expansion joint, a crack and crevice application was used with the applicator tip right up against the expansion joint. On the 1st visit the fipronil was supplemented with a cyfluthrin spray applied as a spot treatment around the edge of the lawn and fence lines. They also used the cyfluthrin along the edge of the lawn next to the driveway as a crack and crevice or spot treatment. After the initial treatment, the company used a 10-cm fan spray of the EcoPCO® WP-X, around all areas of the house foundation, driveway, tree trunks, fence lines, and shrubs during the monthly visits.

Measurement of insecticide runoff. We flushed the driveway from the garage door to the street with 76 L of water as measured by a water meter (AbsolutelyNew Water Saver™ Usage Meter, San Francisco, CA) attached to a hose nozzle. At the curb 1 L of water was collected by making a dam consisting of a U-shaped block of Styrofoam inside a plastic bag. Water collected in the dam was collected with a glass pipette and put into a 1 L amber glass bottle. These samples were kept at 4°C until analyzed for insecticide residues. Samples were collected 1, 28, 65, and 98 d after the initial treatments, and usually within a couple of days of a treatment. There were no significant rain events during this period. Samples were analyzed for bifenthrin, cyfluthrin, and fipronil. Techniques for analyzing botanicals are not readily available at this time and were therefore not measured.

Pesticide analysis. Pesticides were identified using a procedure outlined by Greenberg et al. (2010). Water samples (1000 mL) were extracted with 40 mL methylene chloride three consecutive times using glass separatory funnels. For analysis of fipronil and its metabolites, the residue was recovered in petroleum ether + acetone (70 + 30 by volume; 1.0 mL) and subjected to a further cleanup. The extract (1.0 mL) was then passed through the conditioned cartridge and eluted with petroleum ether + acetone (70+30 by volume; 10mL) at a flow rate of 0.5 mL min^{-1}. The concentrations of target compounds in the final extracts were analyzed using an Agilent 6890 series GC equipped with a Ni63 microelectron capture detector (ECD; Agilent Technologies, Wilmington, DE). An HP-5MS column (30 m×0.25mm×0.25 μm; Agilent Technologies) was employed for separation. The typical retention times for desulfinyl fipronil, fipronil sulfide, fipronil, and fipronil sulfone under these conditions were 10.7, 12.9, 13.1, 15.2 and 17.8 min, respectively. A preliminary experiment showed that the method detection limits for the analytes were 0.001 μg L^{-1}. The recoveries of spiked analytes were higher than 85% using the above extraction and analysis steps.

Statistics. We computed the percent reduction in ant numbers compared to the pretreatment numbers as determined by our sugar water monitoring. Repeated measure (RM) ANOVAs were done on the arcsine-transformed proportions, where “subjects” were houses sampled over time. We did the RM ANOVA over the first 10 wks as well as for each consecutive shorter time period down to weeks 1 and 2. As a follow-up to the RM ANOVAs we did simple ANOVAs at each monitoring date to compare the two protocols. Similar RM ANOVAs for runoff data for fipronil and a simple ANOVA for cyfluthrin were done to compare Protocols 1 and 2. All analyses were done with Systat (2009).

Results

Ant numbers. The RM ANOVAs between the two protocols did not show any significant differences either at the house foundation or yard (F=2.5, df=1,8, P=0.15), and (F=3.3, df=1,8, P=0.10). For wks 2 through 10 there were significantly more ants in the yard than at the house foundation for both Protocols 1 and 2 (RM ANOVA, F=51.3, df=1,8, P<0.001), and (F=13.1, df=1,8, P=0.007), respectively.

Insecticide runoff. Protocol 1. The concentration of bifenthrin from driveway runoff from the granules was near or at the *Ceriodaphnia* EC_{50}. The spot treatments of cyfluthrin for a call back in August and the bimonthly treatments in September resulted in cyfluthrin runoff levels above the *Ceriodaphnia* EC_{50} for days 65 and 98. The concentration of fipronil in the runoff was orders of magnitude below the fipronil EC_{50}, except for day 1, when it slightly exceeded it.

Insecticide Runoff. Protocol 2. The concentration of cyfluthrin in the runoff was below the *Ceriodaphnia* EC_{50} except for the day 1. The concentration of fipronil in the runoff was orders of magnitude below the *Ceriodaphnia* EC_{50} for all samples.

Both companies used the same volume of 0.06% fipronil for treatments on day 0. Analysis of the water samples showed that Protocol 1 had higher concentration of fipronil in the runoff than Protocol 2, but not significantly so over the entire time period (RM ANOVA, F=4.3, df=1,8, P=0.07).

Discussion

Two strategies were tested in these trials. PMP 1 used a more traditional approach, consisting of an initial fipronil foundation treatment supplemented by pyrethroids. In place of a pyrethroid spray the company used bifenthrin granules applied away from impervious surfaces. For their second treatment they did spot treatments with cyfluthrin sprays plus bifenthrin granules where ants were seen. To reduce the amount of insecticides used, this company treated bimonthly instead of monthly. PMP 2 relied more heavily on botanicals on a monthly schedule. Even though the initial treatment was done with fipronil spray and spot treatments with cyfluthrin, PMP 2 used only EcoPCO WP-X, a liquid spray containing 2-phenethyl propionate and other botanical oils (thyme oil and pyrethrins) for all their subsequent monthly treatments.

With respect to ant control, the bimonthly use of more traditional insecticides controlled ants at about the same level as the monthly applications of botanicals. For the first two weeks the Protocol 1 combination of fipronil plus granular bifenthrin gave better control than did the Protocol 2 treatment of fipronil plus cyfluthrin. Thereafter the differences were slight.

The initial bifenthrin runoff in Protocol 1 from the granular product was approx. 150 ppt. This result is similar to an earlier report of about 300 ppt (Greenberg et al. 2010). We have seen pyrethroid runoff this low only with the granular product. By way of comparison, that same article (Greenberg et al. 2010) reported the initial runoff from bifenthrin barrier sprays at about 9,000 ppt.

Both companies used the cyfluthrin spray along the edges of the lawn next to the driveway and around the foundation. It is likely that most of the runoff results from treatments was from the cracks and crevices adjacent to the driveway, which would be in contact with water moving down the driveway. Although the new labeling for pyrethroids prohibits their use on impervious surfaces, elimination of crack and crevice treatments adjacent to the driveway and sidewalk may further reduce pesticide runoff.

Traditional PMP practices included widespread use of pyrethroids in the yards to control ants there. Due to sensitivities about pyrethroid runoff, both companies in this study limited the use of pyrethroids in the yards. Not surprisingly, the level of ant control in the yards was significantly lower than that at the house foundation. Homeowners may be tolerant of the higher numbers in the yard, so long as the ants do not invade the structure. However, if the high number of ants in the yard becomes problematic as some ants invade the structure, then other strategies, such as bait stations and botanicals, could be considered.

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Comparison of two community wide programs targeted to manage red imported fire ants, *Solenopsis invicta* (Buren)

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Community wide fire ant management programs can help reduce red imported fire ant populations and reduce pesticide costs for community residents. By forming community wide programs for neighborhoods, fire ant re-infestation can be reduced or delayed. Two Central Texas neighborhoods have ongoing red imported fire ant community-wide management programs in place. The programs bait for fire ants in spring and fall of each year with residents treating fire ant mounds with the method of their choice between those times. Both neighborhoods are monitored four times a year, before and after each baiting period. The community wide management programs have been developed and carried out in different ways- one hired a pest management company while the other sent an email to residents with a reminder to bait. The neighborhood with professional baiting shows greater reduction in red imported fire ant populations with an increase in other ant genera.

Food Lure Preferences of *Brachymyrmex patagonicus* Mayr (Hymenoptera: Formicidae)

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Laboratory and field trials were initiated to investigate the food lure preference of *Brachymyrmex patagonicus*. Multiple food lures were offered to ants in laboratory assays to determine food preferences of *B. patagonicus* under constant environmental conditions. All food lures were replicated a minimum of five times in both the laboratory