NPMA Final Report
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Dr. Les Greenberg

Project Title: Mitigating Insecticide Runoff from Houses Receiving Treatments for Ant Infestations

Summary

We have developed techniques for measuring insecticide runoff from single houses after treatments for ant infestations. Until now most research on insecticide runoff has sampled water from urban storm drains or creeks to look for insecticides. Those methods reflect runoff from whole communities and cannot be assigned to any specific persons or techniques that were used. Our ability to measure runoff from single homes now allows us to compare specific application techniques by the homeowner or pest management professionals (PMP) both for their efficacy against the ants and for the amount of the runoff produced. Ant efficacy is measured by the amount of sugar water consumed by ants at bait stations. To measure insecticide runoff we collect a 1 L sample from the irrigation runoff and analyze it by gas chromatography to determine the concentration of the insecticide. Using these techniques we compared several application techniques both for efficacy against ants and insecticide runoff.

In this study we compared a standard 1-gal application of fipronil around a house foundation using a fan spray 1 ft up and 1 ft out with a similar application of fipronil as a wet foam. A third treatment was identical to the first but with no treatments done on the driveway and garage door. With respect to insecticide runoff, the foam application had slightly less runoff than the standard treatment for every time period. At 8 weeks a driveway flush showed significantly less runoff when the driveway was not treated. In terms of efficacy, the 3 treatments were similar in outcome, with reductions in ant numbers at 60-80%.

Introduction

Ants are one of the major pests around structures in urban environments (Knight and Rust 1990). Commercial pest management companies throughout California report that 65 to 80% of their pest control services deal exclusively with ants and that Argentine ants make up 85% of the ants sampled by PMPs (Field et al. 2007). A survey of one company showed that 36% of all customer calls concerned ant control, equaling the total for the next three pests (cockroaches, spiders, and bees) combined. A telephone survey in northern California indicated that ants are the most common pest encountered by homeowners and PMPs (Flint 2003). In California, various pest management strategies are used to control Argentine ants in urban settings, which include insecticide baits, sprays, and granules (Knight and Rust 1990, Rust et al. 1996, 2003, Klotz et al. 2007, 2008).

As the use of organophosphates declined during the last decade due to regulations, the use of pyrethroids has increased concurrently. For instance, the amount of permethrin used for structures and landscape maintenance, as reported by licensed applicators, increased from 70,185 kg (active ingredient) in 1997 to 119,508 kg in 2007 . Over the same time period, bifenthrin use increased from 40 to 22,025 kg , and cypermethrin use increased from 41,188 to 88,272 kg (California Department of Pesticide Regulation 2008).

The widespread use of insecticides in residential areas apparently contributes to insecticide contamination of urban surface aquatic systems via irrigation and storm induced runoff. For instance, bifenthrin has been frequently found at concentrations acutely toxic to sensitive aquatic organisms in California urban creeks during both summer irrigation and winter rain events. (Gan et al. 2005, Weston et al. 2005, Budd et al. 2007, Lubick 2008, Weston et al. 2009). Increased attention is being given to these runoff issues by state and federal regulators. Therefore, being able to reduce runoff will become more important in the future and will undoubtedly affect future PMP practices. We have now developed techniques for measuring runoff from individual homes(Greenberg et al. 2010). Therefore, we can compare the runoff from different treatments to find those with the least runoff.

Methods and Materials

For this experiment homes with Argentine ant infestations were selected in Riverside, CA. All of these homes have an irrigated front lawn. Treatments were done during the hot, dry summer of 2010. Excess irrigation water from these homes usually runs across the driveway or sidewalk to the street. Argentine ants are a major problem in the summer, and, with few exceptions, the only water runoff at this time is from lawn irrigation. Each home was treated just once. All households during the hot summer months have daily irrigation in the early morning hours. Daily irrigation continues throughout the trial period, but samples were collected on the specified dates post-treatment.

Ant populations were monitored by using 15-ml vials filled with 25% sucrose water (Figure 1). Ten of these vials are placed around the house's foundation, and an additional 10 are placed away from the house near the property's perimeter. Consumption of the sucrose water over 24 hrs was measured; because we know how much sucrose water one ant can consume, this consumption can be translated into number of ant visits at the reported time intervals (Reierson et al. 1998). Measures of ant populations were done at 1, 2, 4, and 8 weeks post-treatment.

To collect the water runoff at the curb, a custom-made "U" shaped Styrofoam dam is enclosed in a thin plastic can liner and placed firmly against the sides of the street curb (Figure 2). Two small sand bags are used to form a tight seal of the Styrofoam dam with the street. Once water begins to fill the U-shaped cutout, samples are continuously taken from the center of the pooled water using a 60-ml aquatic glass pipette. It takes only several minutes to fill a 1-L amber sample bottle, so it is unlikely for sorption onto the plastic film around the Styrofoam to significantly affect the measured pesticide concentrations. The samples are transported to the laboratory and stored at 4 °C until analysis. All plastic bags and liners are discarded between trials and the aquatic pipette is thoroughly cleaned with soap, deionized water, and acetone. The samples were analyzed by gas chromatography in the laboratory of Dr. Jay Gan, Department of Environmental Sciences, UC Riverside. Water samples were collected pre-treatment and post-treatment at 1 day, 1 week, 3 weeks, and 2 months. Most samples were collected at the curb resulting from the lawn irrigation. The 2 month sample was taken from a 40-gal driveway flush with a hose.

Three treatments were done using 5 houses per treatment:

1. One gallon of 0.06% fipronil using a fan spray around the house, 1 ft up and 1 ft out from the house foundation.

2. A fipronil treatment identical to the first treatment, but without treating the driveway or garage door/driveway interface.
3. A 1-gal 0.06% fipronil treatment applied as a wet foam, 1 ft up and 1 ft out from the house foundation. We used a Jack Plus, handheld 230 oz. applicator for applying the foam. Profoam Platinum, which produces the foam, was added to the fipronil mixture.

Results

Fig. 4 shows the overall efficacy of the treatments (the grand means) as percent reductions in ant numbers. Most reductions were between 60 and 90%. The foam application curve was slightly lower than the others, but the differences were not significant. The standard and no-driveway treatments gave nearly similar results.

Fig. 5 shows the concentration of fipronil in the irrigation water runoff. The two horizontal lines show the effective concentrations (EC_{50s}) that kill 50% of aquatic organisms frequently used as test organisms in measuring the potential for ecological damage. Some of these concentrations were surpassed by the standard and foam treatments, but not by the treatment that bypassed the garage door and driveway. The wet foam treatment had less runoff than the standard treatment over all time periods, although the sample size is not large enough to show a significant result.

Discussion

The slightly lower efficacy and runoff of fipronil when using the foam spray suggests that the active ingredient is being released slower than when applied as a liquid fan spray. More replicates of this study are necessary to show if these differences are significant. This result suggests a longer residual effect of the foam spray. The driveway flush at 2 months shows that the fipronil applied with foam is still present. Since we only recorded data out to 8 weeks we do not know whether the foam application will have a greater residual effect. Future trials could address this question.

Another finding of this study was that by not treating the driveway/garage door interface, significantly less fipronil ran into the street after the 40-gal driveway flush ($P < 0.001$ when compared to either the standard or wet foam treatments). This outcome is not surprising given that no insecticide was applied on the driveway. However, since the driveway is the main runoff conduit to the street, simply not treating this area may significantly reduce runoff from future rain events. Front yards are probably a significant barrier to runoff, while the driveway is an obvious source. Furthermore, Fig. 4 shows that not treating this area did not reduce the efficacy of the treatments. Not treating the driveway may help to mitigate insecticide runoff. New ways of applying pesticides and new formulations should be further tested for their ability to reduce runoff.

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Figure 1. Left: Vial containing 25% sugar water on ground to measure ant consumption. Right: Vial covered with pot to keep out water and animals.

Figure 2. Styrofoam dam and pipette used for water sampling.

Figure 3. Application of wet foam to a a building foundation.

Figure. 4. Efficacy of treatments applied to Argentine ants, using the overall (grand) means.

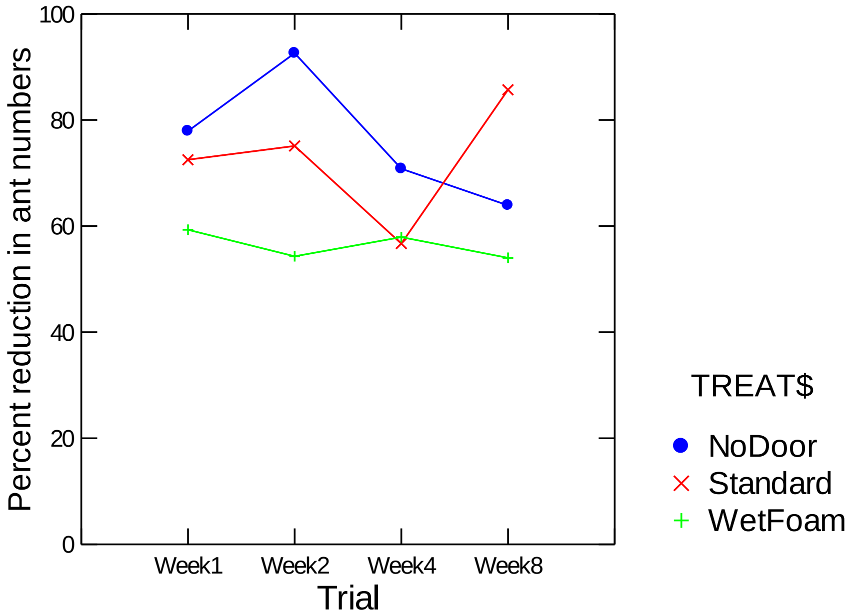

Figure 5. Concentration of fipronil in runoff. The two horizontal lines on the graph show the effective concentrations (EC) that kill 50% of two types of aquatic test organisms.