

End of Year Report for CDPR 2015
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Contract #14-C0102

Treatments on a constructed wall and concrete pad

For a previous contract we constructed on the campus of UCR a wall and concrete pad to simulate a wall/driveway interface. The wall is 3 ft high and 36 ft wide (Fig. 1). The concrete pad narrows down at 10.4 ft from the wall to a spout where water samples are collected (Fig. 2). There are 12 3-ft wide segments on each side of the wall for a total of 24 segments that can be used for treatments. Sprinklers on both sides of the wall are adjusted to give an equal distribution of simulated rain on both the wall and pad. Depending on the type of treatment, the area to be treated is masked with paper and cardboard (Fig. 3). The 1 L water samples were analyzed in Dr. Jay Gan's laboratory for fipronil, fipronil-disulfinyl, fipronil-sulfone, and fipronil-sulfide.

Method. This year we were interested in fipronil runoff. The rates shown were originally calculated for 10 linear ft around a house and then adjusted for 3 ft segments on the wall. There were 3 treatments as shown in the Table 1 below. The standard treatment for homes used 2 quarts of 0.06% fipronil per 160 linear feet, while each of the other treatments used 1 qt, one-half of the fipronil mass of the standard. All treatments were done with a 1-gal B&G tank sprayer with a 4-Way Multeejet Tip. We attached a pressure gauge to keep the tank pressure at 20 psi. The standard and the reduced swath treatments were done with a coarse fan spray setting, while the pin stream setting provided a very narrow but concentrated spray. To do the standard treatment we did two passes of 2.5 secs each (7 ml of 0.006% solution/sec), one pass 1 ft up the vertical wall and the other pass 1 ft out on the pad. For the 6 in x 6 in band we did one pass at 2.5 secs (also 7 ml/sec). And for the pin stream we did one pass at 3.5 secs (5 ml/sec).

Each side of the wall with its 12 segments was considered a block in a randomized block design. There were 3 treatments, with 8 replicates of each treatment, for a total of 24 treated segments on the wall. On each side of the wall, segments were randomly assigned 1 of the 3 treatments. The two sides were treated one week apart. The wall was washed with Liquinox and water before use. Due to constraints on resources no pretreatment samples were done (the wall had last received treatments 1 year earlier) and it was assumed that treatment effects would swamp any residues that could be left on the wall from the previous year after the cleaning. Samples were collected 1 day and 30 days post-treatment. The Office of Pesticide Programs of the US EPA has published aquatic life benchmarks for pesticides. For fipronil the acute benchmark is 0.11 µg/L, or .11 ppb = 110 ppt. The chronic benchmark is 0.011 µg/L, or 11 ppt.

Results. At one day after treatment (Fig. 4), statistical tests show that the 1 qt pin stream application had significantly less runoff than either the 2 qt standard treatment or the 1 qt 6x6 in band treatment (for fipronil and all degradates; $P < 0.05$). The pin stream application had greater than 80% reduction for fipronil and the desulfynil-fipronil (based on median or average concentrations; see Table 2). There were no significant differences between the 6x6 in band and the 1x1 ft band for fipronil or its degradates. The fipronil-desulfinyl was a major contributor to runoff concentration, followed by the parent fipronil. All of the Day 1 runoff amounts for fipronil were above the acute benchmark of 110 ppt (Mean = 5743 ppt; Median = 3156 ppt).

At 30 days post-treatment (Figure 5), there were no significant differences in runoff between the treatments (band widths). However, runoff amounts from the pin stream applications were numerically lower. Table 3 shows 30 day post-treatment runoff means and medians. Most values are below the chronic aquatic benchmark value of 11 ppt, and all are below the acute benchmark of 110 ppt. Within each treatment (band width) the reduction in runoff between day 1 and day 30 for all compounds was > 99%. There was also a significant conversion from parent to sulfone and desulfinyl degradates after 30 days post-application in all treatments (Figure 6).

Discussion. The large reduction in the runoff of fipronil and its degradates at 1 month (> 99%) suggests that this should be the minimal time before the start of the rainy season for spraying fipronil around homes so as to avoid most of its runoff. This finding also applies to the fipronil degradates. Furthermore, a 1x1 in (1 qt) pin stream application was shown to have reduced runoff compared to a 1x1 ft (2 qt) and a 6x6 in (1 qt) application. There were no significant differences in runoff amounts between the 1x1 ft and the 6x6 in applications. It is not apparent why volume of fipronil applied does not seem to be the major factor in volume of runoff, while the band width does seem to be an important factor in this study.

Table 1. Treatments on the constructed wall.

Treatment (Contract Treatment)	Treatment swath at base of wall	Projected treatment area	Actual amount of Termidor SC used/area
Labeled rate (standard treatment) (A)	1 foot up, 1 foot out band application	2 quarts Termidor™ SC per 160 linear feet (320 square feet) (0.2 fl. oz/ft ²)	3.8 µg/cm ²
Pin Stream (C1)	1 inch up, 1 inch out pin stream application	1 qt. of Termidor SC per 160 linear feet (26.67 square feet) (1.2 fl. oz/ft ²)	22.9 µg/cm ²
Reduced swath (D)	6 inches up, 6 inches out band application	1 quart Termidor SC per 160 linear feet (160 square feet) (0.2 fl. oz/ft ²)	3.8 µg/cm ²

Table 2. Day 1 percent reduction between a standard (2 qt) 1x1 ft treatment and a pin stream (1 qt) 1x1 in treatment. For the 1x1 ft and 1x1 in treatments n=8; for the 6x6 in treatment n=7. The table shows fipronil and its 3 most common degradates. There were no significant differences between the 1x1 ft (2 qt) and 6x6 in (1 qt) treatments (not shown). * = $P < 0.05$; ** = $P < 0.01$

Compound	Mean % reduction	Median % reduction
Fipronil	80.2**	92.9**
Desulfynil	84.2**	94.2**
Sulfide	71.6*	87.8**
Sulfone	71.6*	87.3**

Table 3. Thirty day post-treatment wall runoff medians and means in ppt. Most values are below the chronic aquatic benchmark of 11 ppt, while all are below the acute benchmark of 110 ppt. For the 1x1 ft and 1x1 in treatments n=8; for the 6x6 in treatment n=7.

Compound	1x1 ft	6x6 in	1x1 in
Medians			
Fipronil	0.01	0.01	0.01
Desulfynil	12.96	13.13	6.28
Sulfide	5.01	6.02	2.09
Sulfone	6.75	5.87	4.76
Means			
Fipronil	5.15	7.33	3.69
Desulfynil	23.97	13.75	8.58
Sulfide	5.53	6.63	2.57
Sulfone	10.46	9.28	4.88

Figure 1. One side of constructed wall showing 12 3-ft wide segments



Figure 2. Collecting a 1 L water sample for analysis.



Figure 3. Masking an area to be treated. This example was 2-ft up and 3 ft out.



Figure 4. Runoff at one day after application from treatments applied to the constructed wall located on the UC Riverside campus.

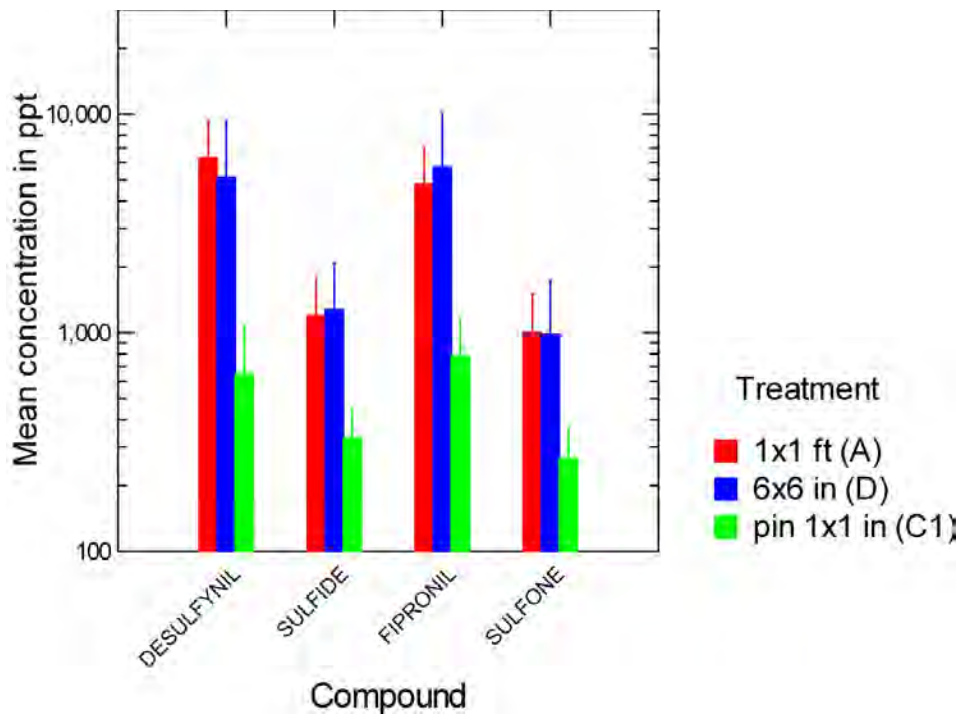


Figure 5. Runoff at 30 days after application from treatments applied to the constructed wall located on the UC Riverside campus.

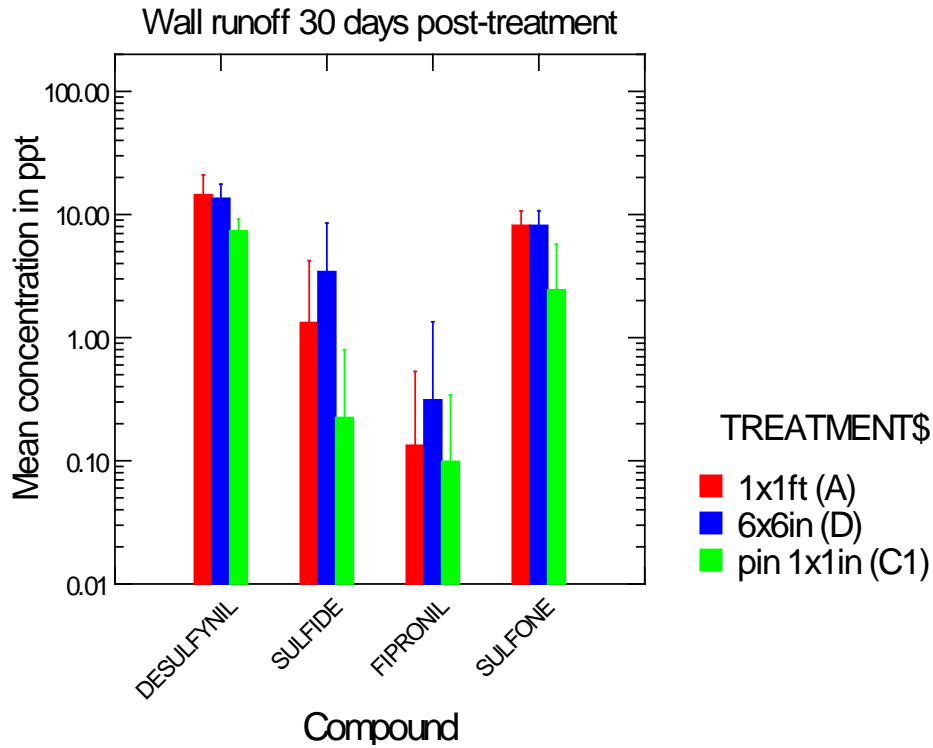


Figure 6. Relative contributions (%) of fipronil and degradates from constructed wall runoff.

