Quantification of Pesticide Runoff from Urban Landscapes

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INTRODUCTION

The potential for pesticide runoff from urban landscapes continues to gain increased public attention as well as environmental concern. Turfgrass professionals and homeowners, in urban landscapes, control weed and insect pests using herbicides and insecticides. When such pesticides are inadvertently applied to impervious surfaces such as driveways and/or sidewalks in urban landscape settings, there may be a greater potential for contaminating bodies of water, by surface runoff, when compared to a pervious surface such as turf. The objective of this study is to quantify the potential runoff of turfgrass pesticides when applied to pervious (turf) and impervious (concrete) surfaces.

MATERIALS AND METHODS

Site Preparation

Eighteen 8 x 14 foot plots were established; nine were paved with concrete and nine were comprised of a four-cultivar blend of Kentucky bluegrass (*Poa pratensis* L.). Each plot was equipped with flumes, three-way sample splitters, and runoff collection bins. The study site has an average slope of 5.78%. Each plot was edged with both galvanized steel and plastic-edging borders to minimize runoff overflow. Plots were mowed at 6.35cm height on 5 to 7-day intervals using a rotary- mulching mower and clippings were not collected. The plots received automatic irrigation twice weekly to replace evapotranspiration (ET) losses.

Experimental Design and Treatment Applications

Design: RCB, 3 replications of each treatment
Pesticide application dates: Respective plots received either a turfgrass professional or Homeowner maintenance regime (Table 1).
Application method: Turfgrass insecticides and herbicides were applied to both turf and concrete surfaces. Granular products were applied with a Gandyä drop spreader. Liquid products were applied with a Tee Jet® Lawn Spray Gunä and CO_2 backpack sprayer.

Sampling and Data Analysis

A 50ml sample was collected after each rainfall or irrigation event from respective collection bins. The pesticide residue was extracted by passing the 50ml sample through a Carbograph solid phase extraction (SPE) tube. The sample was injected into a high-pressure liquid chromatography (HPLC) machine to determine concentration amounts. Concentrations of imidacloprid were found in femptamoles ($1x10^{-15}$) per injection, these units of measure were adjusted to mg L^{-1}.

RESULTS AND DISCUSSION

Concrete surfaces yielded a considerable amount of water runoff compared to the turf surfaces. Turf runoff (Figure 1) occurred in substantial amounts during February, yielding approximately 73.6 liters of runoff in the turf plots. Another substantial runoff event occurred in June when 15.13mm of rain fell in less than three days, yielding an average of 8.5 liters of runoff in all turf plots. Turf plots adjacent to concrete plots had occasional runoff, this may be a result of the concrete plots overflowing. Turf plots adjacent to non-concrete plots only yield runoff for the two dates listed. Runoff from turf surfaces was negligible to concrete surfaces during the remainder of the year. Concrete runoff (Figure 2) also demonstrates two runoff peaks in February and in June.

Analysis of the runoff for imidacloprid concentrations in turf plots resulted in decreasing amounts. Runoff from concrete plots was also analyzed for imidacloprid concentrations, however amounts of imidacloprid were detected in the controls. This may be explained by several factors: either overflow or subsequent cross-contamination from adjacent concrete plots that were treated with imidacloprid, or possible sample contamination during the analysis with the HPLC. As a result, this treatment will be repeated.

CONCLUSIONS

As hypothesized, when comparing the runoff collected from the turf and concrete plots, substantially more runoff occurred in the concrete plots. However, when abundant rainfall (> 15mm) or snowmelt occurred, turf plots exhibited ample runoff, but not equivalent to that of the concrete runoff. The results of the data analysis from the concrete and turf runoff samples revealed a decreasing amount of imidacloprid concentration over time (Figure 3). Unexpectedly, imidacloprid was detected on all sample dates regardless of day after treatment application (i.e., 0, 7, 14, and 28) and respective surface. Additionally, less concentration of imidacloprid was detected in turf samples compared to concrete samples, 3mg L^{-1} in turf samples and 16mg L^{-1} in concrete samples. These data only include the first year of the imidacloprid data. The herbicides 2,4-D, MCPP, MCPA, Dicamba, and Triclopyr are currently be analyzed.

Table 1. Pesticide application dates for runoff study.

Date	Pesticide		Active Ingredient
August 17, 1999	GrubEX	(Homeowner)	Imidacloprid
	Merit	(Professional)	Imidacloprid
October 15, 1999	Weed-B-Gon	(Homeowner)	2,4-D, MCPP, Dicamba
	Horse Power	(Professional)	MCPA, Dicamba, Triclopyr
April 5, 2000	Scott's Turf Builder	(Homeowner)	Pendimethalin
	Barricade	(Professional)	Prodiamine
June 9, 2000	Diazinon	(Homeowner)	Diazinon
	Dursban	(Professional)	Chlopyrifos
July 19, 2000	GrubEX	(Homeowner)	Imidacloprid
	Merit	(Professional)	Imidacloprid
October 23, 2000	Weed-B-Gon	(Homeowner)	2,4-D, MCPP, Dicamba
	Horse Power	(Professional)	MCPA, Dicamba, Triclopyr

Figure 1. Amount of turf runoff (Liters per plot) for Homeowner, Professional, and Control plots compared to rainfall (mm).

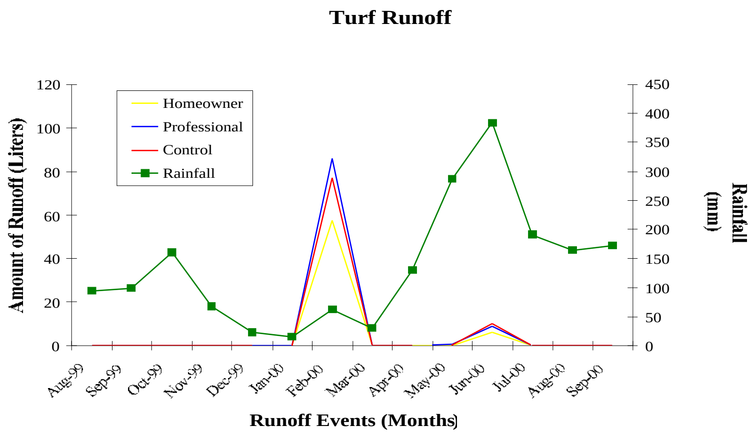

Figure 2. Amount of concrete runoff (Liters per plot) for Homeowner, Professional, and Control plots compared to rainfall (mm).

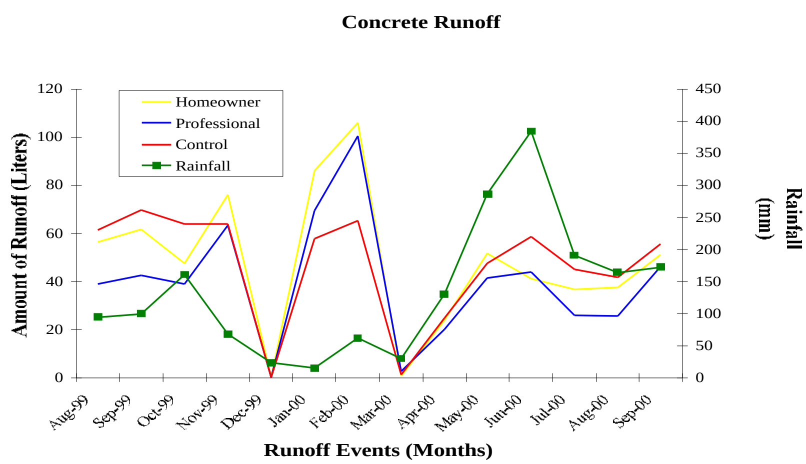

Figure 3. Analysis of imidacloprid concentrations in turf and concrete runoff.