Measurement and Model Prediction of Pesticide Partitioning in Field-Scale Turfgrass

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Goals:

- *Determine the partitioning of commonly-used turfgrass pesticides among the components of a turfgrass system including the atmosphere, soil, soil-water, leachate, thatch, verdure, and clippings.*

- *Assess the ability of mathematical models, such as CHAIN_2D and PRZM2, to accurately predict pesticide movement in a field-plot-scale turfgrass system.*

- *Modify the mathematical model and/or change the data collection protocol as necessary to improve the accuracy of model predictions.*

- *Test the model using independently-derived data to assess further its predictive capabilities.*

- *Conduct a sensitivity analysis of the mathematical model to determine which input parameters have the greatest effect on the model predictions and therefore should be known to the highest degree of accuracy.*

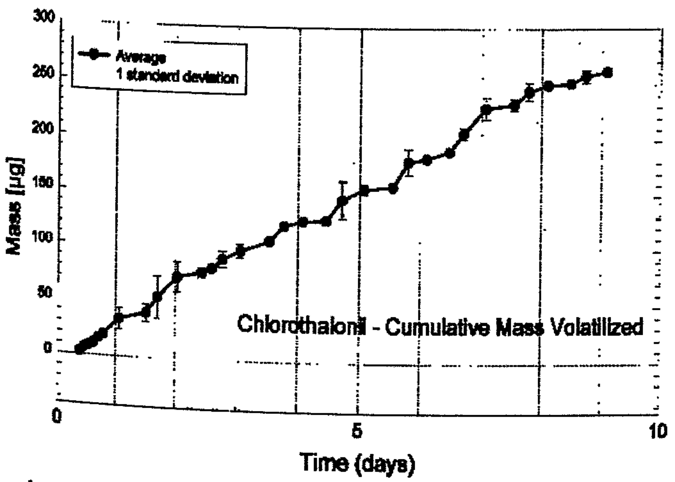
Concern over environmental contamination by pesticides has become widespread during the last several years. The United States Environmental Protection Agency has established mandatory standards for several pesticides, including 2,4-D, glyphosate, and atrazine, in drinking water. In addition, several states have established regulations to limit further environmental contamination by pesticides.

In California, pesticides that are detected in groundwater or have potential to leach to groundwater are regulated by the Department of Pesticide Regulations (DPR). Recently, the California DPR proposed that several pesticides be designated as toxic air contaminants. This list includes several compounds commonly used on turfgrass, including carbaryl (Sevin®), 2,4-D, mancozeb, maneb, and trifluralin (Treflan®).

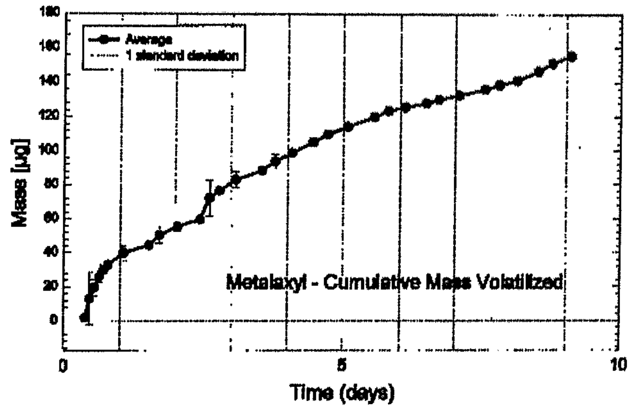
Previous USGA-funded research at the University of California, Riverside (UCR) indicated that less than 0.1 % of the applied carbaryl was lost by volatilization and leaching through the putting green plots. More of the applied 2,4-D could be accounted for: approximately 1% volatilized into the atmosphere, and approximately 5% leached through the soil. However, in both cases, more than 90% of the applied compound was not accounted for. In this project, we are performing more detailed analysis of the fate of pesticides in field plots to enable a determination of the mass balance.

A second area of concern after the first three-year cycle of environmental fate research was the need to be able to predict ground-water concentrations of pesticides. It is usually not feasible to monitor ground water for the pesticides of concern, so measurements of pesticide concentrations in the near-surface soil and soil water are made. Mathematical models are then used to predict the concentration of pesticides that one might expect at deeper points in the subsurface. Smith and Bridges (1993) attempted to predict pesticide movement through their greenhouse lysimeters using the GLEAMS (Groundwater Loading Effects of Agricultural Management Systems). They found that the model significantly over-predicted the amount pesticides that would leach through the soil even when a thatch layer was included in the model.

There are several possible explanations for the model's predictions failing to match experimental data. One is that this model is very simple from a hydrologic standpoint: it



A volatilization flux chamber (16 in. X 16 in.) was placed directly on the turf in each designated plot. The air above the turfgrass surface was pulled out of the chamber at a very low rate (approximately 10 liters/minute). The cumulative mass of chlorothalonil that volatilized from the putting green plots was 0.017% of the total applied mass.



The cumulative mass of metalaxyl that volatilized from the putting green plots was 0.083% of the total applied.

assumes that when water is applied to the soil surface, it uniformly displaces an equal volume of water from the underlying soil (the so-called "tipping bucket" model). It is also a one-dimensional model in that it assumes that the water and pesticides are moving in one dimension. This model is classified as a functional, management-level model because it incorporates certain simplifications in the subsurface processes that reduce the requirement for input data. One advantage of a model such as GLEAMS is that it does not require massive amounts of difficult-to-acquire input data. The subsurface processes, and their ability to accurately predict chemical movement may be decreased. There is a need to investigate the ability of other more sophisticated, albeit more data-intensive models, to predict chemical movement through turfgrass-soil systems.