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 mathematical models and/or change the data collection protocol as necessary to improve the accuracy of model predictions.*
- *Test the model using independently-derived data to further assess 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.

Previous USGA-funded research at the University of California, Riverside (UCR) indicated that less than 0.1 percent 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 percent volatilized into the atmosphere, and approximately 5 percent leached through the soil. However, in both cases, more than 90 percent 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 is the need 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.

The cumulative volatilization of metalaxyl was 0.08 percent of the applied mass. This was higher than predicted by the

model (0%); however, it is a negligible amount. For 120 days after application, the concentration of metalaxyl in the upper 2 cm of soil decreased substantially. The concentration of metalaxyl in the leachate was negligible for the first 50 days of the experiment, and then rose to a peak at 75 days.

This is in good agreement with the model predictions, which estimated that none of the applied mass would leach during the first 30 days. The mass of metalaxyl that leached during the experiment was 0.072 percent of the applied amount. Approximately 0.139 percent of the applied mass was removed from the turfgrass clippings.

The mass of chlorothalonil that volatilized during the experiment was 0.017 percent. The model predicted that 0.6 percent of the applied mass would volatilize within 7 days of application. Detectable concentrations were seen throughout the entire soil profile by day 2 of the experiment, and measurable concentrations were detected at all depths at day 15.

The model predicted that none of the chlorothalonil would be detected in the leachate. In this experiment, detectable concentrations of the compound were found for at least 150 days. However, the concentrations were very low (less than 0.25 ppb). Only 0.0012 percent of the applied mass of chlorothalonil leached through the rootzone. The total amount of chlorothalonil removed in the clippings was 0.137 percent of the total applied.

The cumulative volatilization of chlorpyrifos was 15.7 percent of the applied mass. Essentially no chlorpyrifos was detectable in the soil below a depth of 20 cm. No discernible chlorpyrifos peak was observed in the leachate; the concentrations measured were very low, and near the analytical detection limit for the compound. A very small fraction (0.00037%) of the compound leached through the soil. Approximately 0.237 percent of the applied mass was removed from turfgrass clippings.

The mass of trichlorfon that volatilized during the experiment was 0.094 percent. Detectable concentrations were seen throughout the entire soil profile by day 2 of the experiment, and measurable concentrations were detected at all depths at day 90. Concentrations of the compound in the leachate were found for 72 days. The concentration peaked at about day 20, and moved through the system in a pulse for another few weeks. Only 0.003 percent of the applied mass of trichlorfon leached through the rootzone . The total amount of trichlorfon removed in the clippings was 0.05 percent of the total applied.