

# Evaluation and Calibration of Pesticide and Nutrient Transport Prediction Models

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## **Environmental & Turf Services**

### **Goals**

- *Develop a questionnaire that can be administered to university researchers to help provide the site characterization data and results critical for computer modeling.*
- *Obtain pesticide leaching and runoff data from USGA-funded researchers, and fill in data gaps where necessary.*
- *Calibrate the computer simulation models PRZM and GLEAMS against the volumes of percolate water and runoff water obtained from the test plots.*
- *Calibrate the models against the pesticide leachate and runoff results.*
- *Evaluate the model performance in terms of validity and parameter sensitivity. Provide guidance on the use of the models for turf and the possible need for modifications of the models to make them more appropriate for turf.*

### **Cooperators:**

Tom Durborow  
LeJan Barnes

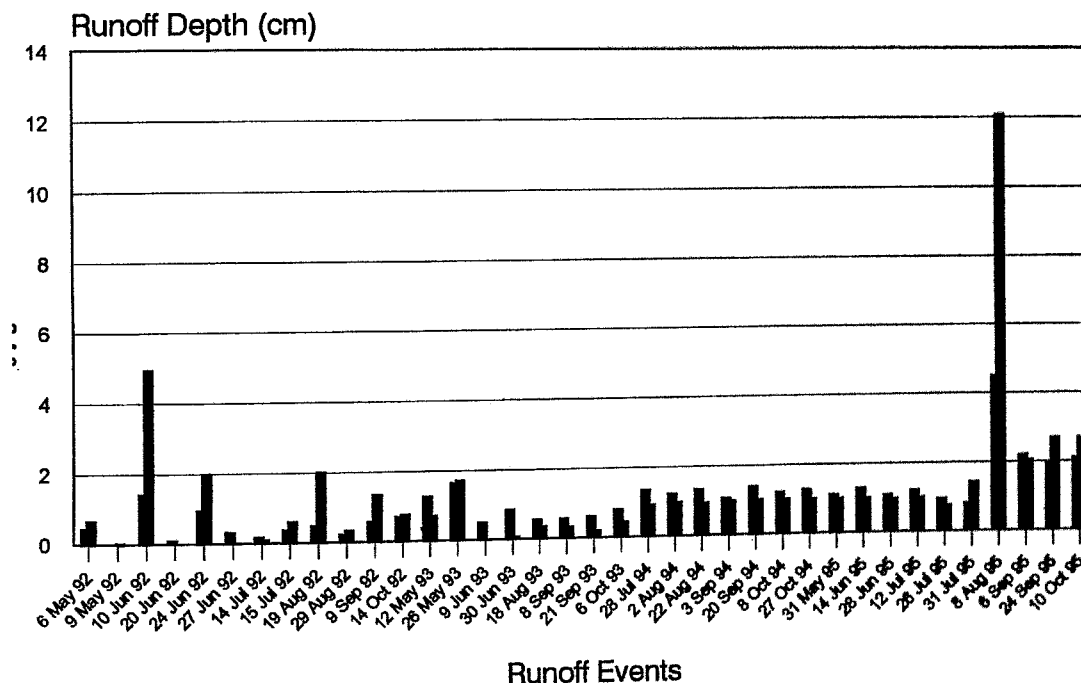
The purpose of this study is to evaluate the applicability of two pesticide fate models to turf. These models were developed and have been mostly used for assessing the fate of agricultural pesticides. The models are PRZM (EPA's Pesticide Root Zone Model) and GLEAMS (USDA's Ground Water Loading Effects of Agricultural Management Systems model).

### **First Phase (Completed)**

The first phase of this project was completed last year. A comprehensive, two-volume report was issued April 12, 1996. We had good results calibrating the GLEAMS model against Dr. Al Smith's results from 12 runoff turf plots. We only had mixed success calibrating PRZM against the University of Georgia leachate data from different plots. However, we have recently received soil moisture curve data from Dr. Smith that, after clarification, will allow us to reexamine and possibly improve our previous analyses.

### **Second Phase (Current)**

Model Selection. We are using EPA's latest version of PRZM, version 3.0, for our runoff assessment as well as our leaching assessment. This version of PRZM should become widely available within the next six months. We had previously used version 2.0 for our leaching assessment only. This version was known to overestimate pesticide runoff which was one reason why we chose GLEAMS to assess pesticide runoff in that phase. We are not using



**Figure 17. Plot of observed (first bar) versus predicted (second bar) using PRZM r3.0 runoff simulation model. Observed data was from the ryegrass runoff plots at Pennsylvania State University collected during 1992-1995.**

GLEAMS in the current phase for two reasons: the runoff problem with PRZM has been resolved, and EPA prefers to use PRZM (although EPA will still accept GLEAMS assessments with proper documentation).

**Runoff.** We are calibrating PRZM against data generated at Pennsylvania State University. Creeping bentgrass and perennial ryegrass were maintained at three-quarter inch height. Simulated rainfall was applied at the rate of 6 inches per hour. The pesticides MCP (mecoprop), isazofos, and triadimefon were applied and analyzed. The triadimefon metabolite triadimenol also was detected. Generally, 0.5 to 10 percent of the applied pesticide ran off. There were insufficient data available on the soil

properties, so we sampled the soils and had them analyzed.

We have put much effort into reproducing the hydrology (actual event-specific runoff water volumes) and we have obtained moderate success (Figure 17). More calibration work was required than desired due to one or both of the following factors.

The PRZM crop model is not as conducive to describing turf as the GLEAMS crop model. For example, GLEAMS gives the option of growing a perennial crop whereas PRZM does not. One is not able to directly model turf going dormant with PRZM. GLEAMS focuses more on the management of the crop and PRZM focuses more on the processes.

The Pennsylvania State University researchers did not measure the actual irrigation/rainfall applied to the surface. We could only estimate the actual water received by the surface based on the rainfall simulation design and the length of time the system was turned on. It is possible that a significant fraction of the fine droplets drifted off site. We have just begun to model the pesticide runoff.

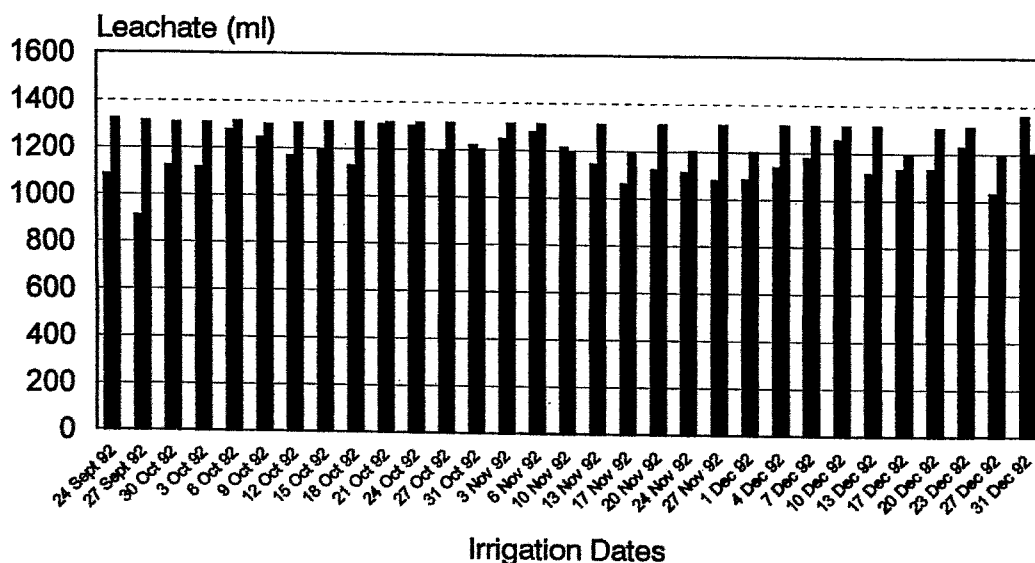
**Leachate.** We are calibrating PRZM against the results of Dr. Garald Horst at University of Nebraska. Field turf plots (Kentucky bluegrass in a silty clay loam) were harvested for the greenhouse experiment in 1992. Porous ceramic plates were attached to the bottom of the soil cores to simulate the field environment matric potentials and to avoid creating a perched water table at the bottom of the cores.

Seven pesticides were applied to the lysimeters (soil cores) and two irrigation regimes were used. We are modeling the

cores irrigated at two inches every three days, and treated with the following four pesticides: MCP, 2,4-D, isazofos and chlorpyrifos.

Observed vs. predicted water leachate volumes on a daily basis had excellent agreement. The coefficient of variation was 10.4 percent, despite the fact that no calibration (tweaking of the model) was done. However, it should be noted that: 1) PRZM predictions are slightly to moderately high on all but three dates; and 2) the spread of observed percolate volumes was not large, thereby somewhat reducing the toughness of the test for PRZM.

Surprisingly, we are having difficulty matching predicted vs. observed pesticide leachate. We say "surprisingly" because the general rule of thumb is that successful and easy hydrology calibration usually leads to good chemical leachate (or runoff) predictions. We are continuing to examine this significant discrepancy.



**Figure 18.** Observed leaching (first bar) and predicted (second bar) using PRZM r3.0 simulation model. The data was from University of Nebraska greenhouse soil cores collected during fall and winter 1992.