Operational Comprehensive Fate and Transport Model for Turfgrass Pesticides

Douglas A. Haith
Cornell University

Objectives:

1. Continue the ongoing development and testing of runoff and volatilization models for turfgrass pesticides.
2. Combine runoff and volatilization models into an operational fate and transport model for surface movement of turfgrass pesticides.
3. Initiate development and testing of models for estimating leaching of turfgrass pesticides to groundwater.
4. Add a leaching component to the surface transport model to produce a comprehensive fate and transport model for turfgrass pesticides.

Start Date: 2001
Project Duration: 2 years
Total Funding: $31,900

The most useful tools for predicting chemical behaviors in the environment are so-called "fate and transport" models. These are mathematical descriptions of chemical transformations and transport that are converted into computer programs or software which can be run for any chemical or site of interest. We have thus far developed fate and transport models for turf pesticide runoff and volatilization and are currently testing a combined model of pesticide runoff, volatilization, and leaching.

Much of this year's research was devoted to assessment of human health risks from inhalation of volatilized turf pesticides. We combined our volatilization model with an atmospheric transport model in order to estimate concentrations of pesticide vapors which would be breathed by a golfer during a typical 18-hole round. This information was used to determine the golfer's exposure or "dose" of inhaled pesticide that would be received if she or he played every day.

For example, Figure 1 shows a golfer's one-week exposure to trichlorfon following the pesticide's application in May or August as calculated by the model for three locations. The exposures differ by factors or two or three with time of the year and location. These variations are due mostly to weather differences. Low temperatures and brisk winds tend to reduce volatilization and enhance movement of the pesticide away from the greens and fairways.

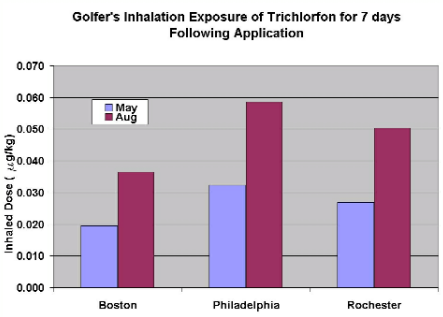

Figure 1. A golfer's one-week exposure to trichlorfon following the pesticide's application in May or August as calculated by the models for three locations.

Of course, the real issue is the impact of these exposures on golfer health. Such an evaluation requires estimates of LADD, or "lifetime average daily dose", which we define as the average daily inhalation of pesticide an adult golfer would receive from playing an 18-hole round every day of the year. Using our models, we determined LADDs for 15 chemicals typically used in turf pest control programs in the Northeast: azoxystrobin, bensulide, chlorothalonil, cyfluthrin, halofenozide, iprodione, mancozeb, MCPP, oxadiazon, PCNB, propiconazole, thiophanate-methyl, triadimefon, trichlorfon, trinexapac-ethyl.

Following the general procedures used by the USEPA to assess pesticide health risks, we evaluated the chemicals in two ways. First, we compared LADDs with USEPA's "chronic reference doses" which are considered the daily exposures which over a 70-yr life span produce no harmful effects, excluding cancers. None of our computed LADDs exceeded 1% of the chronic reference doses, indicating that golfer inhalation of the pesticide vapors is unlikely to produce chronic, non-cancerous health problems.

However, five of the pesticides are suspected carcinogens, and it was also necessary to evaluate associated cancer risk. For this purpose, we combined LADDs with USEPA's "cancer potency factors" to estimate the incremental cancer risk resulting from these inhaled pesticide doses. These risks are estimates of the additional probability that a golfer has of getting cancer over his or her lifetime.

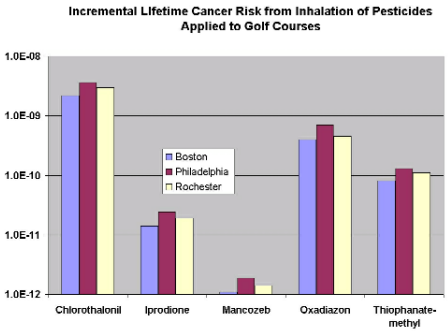

Figure 2. LADDs (lifetime average daily dose) were combined with USEPA's "cancer potency factors" to estimate the incremental cancer risk resulting from these inhaled pesticide doses. It appears that cancer risks are not significant.

The resulting risk estimates are shown in Figure 2 for the three study locations. The numbers may be interpreted as 'one in a (million, billion, etc.). Thus 1.0E-09 is one in a billion (109), and 1.0E-10 is one in ten billion (1010), etc. A generally accepted risk level is one in a million (1.0E-06), and since all of the pesticide risk levels are much smaller than this, it appears that cancer risks are not significant.

Summary Points

- Golfer exposure to pesticide vapors is highly influenced by weather, and thus varies significantly with location and time of the year.
- A risk assessment of volatilization of 15 turf pesticides used in the Northeast indicated that golfer inhalation of the chemical vapors is not likely to produce long-term health problems.