Operational Comprehensive Fate and Transport Model for Turfgrass Pesticides

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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.

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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 developed fate and transport models for turf pesticide runoff and volatilization. These two models are now being combined into a single comprehensive model of surface pesticide behavior. Most of our recent effort was directed at modifying the volatilization model to work with the same daily weather data required by the runoff model.

When compared with field measurements for eight pesticides, volatilization estimates produced from this simpler model were as accurate as those obtained from the earlier, more complex model. We are now moving ahead with software development and testing of the comprehensive runoff and volatilization model.

The TurfPQ pesticide runoff model was used to simulate the runoff of 15 pesticides commonly applied to creeping bentgrass fairways and greens on golf courses in the northeastern U.S. Simulations produced 100-year daily records of water runoff, pesticide runoff, and pesticide concentration in runoff for three locations: Boston, MA, Philadelphia, PA, and Rochester, NY. Results were summarized as annual and monthly means and annual maximum daily loads (AMDLs) corresponding to 10- and 20-year return periods.

Mean annual pesticide runoff loads did not exceed 3% of annual applications for any pesticide or site, and most losses were substantially less than 1% of application. However, annual or monthly mean concentrations of chlorothalonil, iprodione and PCNB in fairways' runoff often exceeded LC_{50} concentrations for aquatic organisms. Concentrations of azoxystrobin, bensulide, cyfluthrin, and trichlorfon in extreme (1-in-10 year, or 1-in-20 year) events often approached or exceeded LC_{50} levels.

Pesticides and nutrients are most prone to runoff when applications are soon followed by significant rainfall or heavy irrigation.

Concentrations of halofenoxide, mancozeb, MCPP, oxadiazon, propiconazole, thiophanate-methyl, triadimefon, and trinexapac-ethyl were well below LC_{50} levels, and turf runoff of these chemicals does not appear to be hazardous to aquatic life in surface waters.

Use of "fate and transport models", such as TurfPQ developed at Cornell University, can assist superintendents in their efforts to protect surface and groundwater from pesticides and nutrients.

Summary Points

- Volatilization and runoff models have been modified so they can be combined into a single comprehensive model of surface pesticide losses from turf.
- Evaluation of 15 turf pesticides used in the Northeast indicated that seven of the chemicals may produce concentrations in runoff that exceed toxic levels for aquatic organisms.