Managing Pesticide Exposure from Treated Turf

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Objectives:

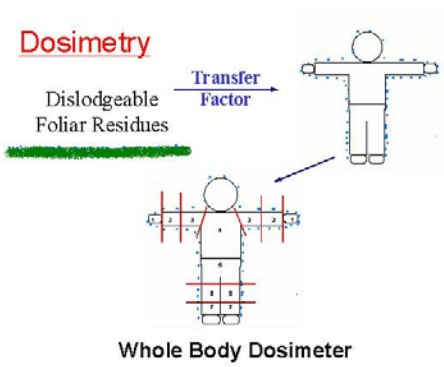
1. Evaluate management practices that reduce the potential for golfer exposure to volatile and dislodgeable foliar residues of turfgrass pesticides.
2. Examine the relationship between dislodgeable foliar and volatile residues and actual golfer exposure, and develop an accurate exposure model using experimentally determined pesticide transfer and penetration factors.

Start Date: 2000
Project Duration: 3 years
Total Funding: $74,867

Accurate assessment of pesticide exposure to golfers requires knowledge of the availability of pesticide residues following application, transfer and absorption processes of these residues, as well as major routes of entry into the body. Our past research used dislodgeable foliar and volatile pesticide residues to estimate pesticide exposure to golfers. The research established that there are volatile and dislodgeable foliar residues available for golfer exposure, and that not all of these exposures can be deemed "safe" using the USEPA Hazard Quotient (HQ) criteria.

We are currently evaluating the optimal use of post-application irrigation, reentry intervals (e.g., evening pesticide applications), application of less toxic pesticides, and application strategies that result in less-than-full coverage (e.g., tees and greens only) to minimize exposure.

We have also concurrently evaluated exposure in over 100 rounds of golf over a four-year period following the application of three major insecticides, chlorpyrifos (Lorsban), cyfluthrin (Tempo), and carbaryl (Sevin) in cooperation with the USDA and the New England Research Turfgrass Foundation Inc.



Dosimetry involves measuring pesticide residues on full body cotton suits, gloves, and personal air samplers.

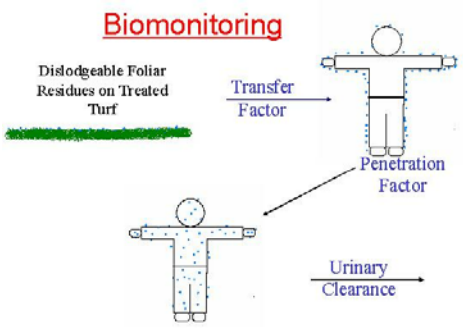
This part of the project emphasizes dosimetry (measuring pesticide residues on full body cotton suits, gloves, and personal air samplers) and biomonitoring (measuring urinary pesticide metabolites) to determine transfer and penetration factors. The direct and simultaneous determination of dosimetry and biomonitoring data provides a novel and complete database on how much pesticide is actually transferred to and absorbed by a individual during a round of golf.

This exposure data, together with dislodgeable and volatile residue data, has allowed us to develop a new golfer exposure model. Using the total pesticide dose derived from biomonitoring data, this model can be used to accurately predict golfer exposure based solely on dislodgeable foliar residues. With this information, a simple cheesecloth-wipe sample from the grass surface is sufficient to realistically predict exposure in most situations.

Exposure estimates made using biomonitoring and dosimetry data are significantly less (2- to 15-fold) than previous estimates using environmental data (volatile and dislodgeable foliar residues). This type of information is critical to reduce the individual contributions of pesticides to the USEPA FQPA "Risk Cup" evaluation of agrochemicals, including turf pesticides.

Dermal pesticide exposure has been found to be the most significant route of exposure to golfers (> 92 %) for all pesticides studied. However, dislodgeable residues rapidly decline over the first hour "drying-in" period and the potential for dermal exposure is dramatically reduced following a one-hour re-entry interval following application and irrigation events. The lower legs and hands are the most vulnerable dermal routes of exposure.

Exposure estimates based on a one-hour re-entry interval following full-course and full-rate applications of chlorpyrifos, carbaryl, and cyfluthrin are substantially below USEPA's HQ and Acceptable Daily Intake (ADI) values, indicating safe exposures. The highest HQ value determined (0.08) using dosimetry and/or biomonitoring techniques occurred following the worst-case scenario applications of chlorpyrifos.



Biomonitoring involves measuring urinary pesticide metabolites.

Experiments performed using less toxic and less volatile pesticides (i.e., carbaryl and cyfluthrin) resulted in significantly reduced HQs, indicating wide margins of safety. Additionally, there was an 83-92% reduction in the amount of chlorpyrifos absorbed following application to only tees and greens.

Application of full-rate cyfluthrin resulted in no detectable residues in either the dosimeters or in golfer urine. These results show that operational practices such as reentry intervals, reduced application area, and use of less toxic pesticides, do attenuate exposure and hazard.

Summary Points

- Exposure estimates using biomonitoring data are 2- to 15-fold less than previous estimates using volatile and dislodgeable foliar residue data.
- Several management practices including the optimal use of post-application irrigation, enforcement of a one-hour re-entry interval, use of less-toxic pesticides, and partial course applications can significantly reduce exposure.