Managing Pesticide Exposure from Treated Turf

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Objectives:

1. Determine the level of hazard of volatile and foliar dislodgeable residues of the reduced-risk pesticides carfentrazone, halofenozide, and azoxystrobin following full course full rate applications.
2. Determine the effect of partial course application strategies (e.g. tees and greens) and post application irrigation on volatile and foliar dislodgeable pesticide residues following full-rate applications of carfentrazone, halofenozide, and azoxystrobin.
3. Model the relationship of volatile and dislodgeable foliar residues vs. actual golfer exposure using urinary biological monitoring techniques or, for pesticides that are not amenable to biomonitoring, dosimetry techniques.

Start Date: 2007
Project Duration: three years
Total Funding: $90,000

This study seeks to determine actual levels of pesticide exposure to golfers following application of turfgrass pesticides. A major deliverable of this research is to develop a model for use by the turf industry and regulatory agencies that accurately predicts golfer exposure using easily collected environmental residue data. Dermal exposure and inhalation of airborne pesticide residues are the primary routes by which golfers are exposed to pesticides following application.

The fate of pesticides after application largely determines how much of it is available for potential human exposure. This is influenced by many factors including post-application irrigation, application rate, and strategies such as partial course application, as well as the physicochemical properties such as water solubility and volatility of the pesticide itself. To understand these factors, we have analyzed pesticide residues in the air and on turfgrass (dislodgeable foliar residues, DFRs) in over 35 pesticide applications using either chlorpyrifos, carbaryl, cyfluthrin, chlorothalonil, 2,4-D, MCPP-p, dicamba, and imidacloprid.

To determine precisely how much of the environmental residues are actually transferred to golfers during a round of golf, we measure exposure to volunteer golfers using dosimetry (measuring pesticide residues on full body cotton suits and personal air samplers) and biomonitoring (measuring urinary metabolites).

Dosimetry and biomonitoring, together with concurrently collected dislodgeable foliar and airborne residue data, provides a unique database on golfer exposure and has allowed us to develop a golfer exposure model. The central predictor of exposure in the model is the transfer factor (TF), which is ratio between the pesticide residues measured in the environment versus the amount that actually ends up transferring to the golfer (as measured by dosimetry). We will compare the biomonitoring and dosimetry results for these "reduced risk" compounds with those previously determined for chlorpyrifos, carbaryl, cyfluthrin, 2,4-D, MCPP, dicamba, chlorothalonil, and imidacloprid.

Regulators and health professionals now consider biomonitoring data the "gold-standard" for measuring pesticide exposure, and we have used this to validate our TF model for chlorpyrifos, carbaryl, cyfluthrin, chlorothalonil, MCPP, and dicamba. This season (2007), we determined exposure in 16 rounds of golf following application of carfentrazone without post-application irrigation.

To date, HQs determined for chlorpyrifos, carbaryl, cyfluthrin, 2,4-D, dicamba, and chlorothalonil and imidacloprid have been 20- to 300- fold below 1.0, indicating safe exposure levels using the EPA Hazard Quotient criteria. Conversely, HQs calculated for MCPP were greater than 1.0 (1.8). It is important to note that carfentrazone is considered a "reduced risk" replacement for the phenoxy acid herbicides (2,4-D, MCPP, and dicamba).

Although biomonitoring is considered the gold standard, not all pesticides are amenable to this approach. Some pesticides do not possess a good urinary metabolite, or the pharmacokinetics (absorption, distribution, metabolism, and excretion) of the compound may not be available. In these cases, the TF model will still allows us to calculate a hazard quotient in a meaningful fashion.

Pesticide exposure was measured by dosimetry and biomonitoring. Dosimetry group (on right) wore full body cotton suits and personal air samplers. Biomonitoring group (on left) wore matching suits cut to simulate normal golfer attire.

Summary Points

- Researchers have evaluated exposure in 16 rounds of golf following the application of carfentrazone and will compare this and future results from halofenozide (2008) and azoxystrobin (2009) with those results of previous experiments on chlorpyrifos, cyfluthrin, carbaryl, chlorothalonil, 2,4-D, MCPP-p, dicamba, and imidacloprid.
- Determination of golfer exposure to "reduced risk" pesticides will provide a novel dataset for these IPM-compatible compounds.