Utilizing Reduced-risk Pesticides and IPM Strategies to Mitigate Golfer Exposure and Hazard

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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 total course and full-rate applications.
2. Determine the effect of partial course application strategies (e.g. tees and greens only) 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 golfer exposure to "reduced-risk" pesticides following application to turfgrass. The fate of pesticides after application largely determines how much of it is available for potential human exposure.

We have analyzed pesticide residues in the air and on turfgrass (dislodgeable foliar residues, DFR) in 43 pesticide applications using either chlorpyrifos, carbaryl, cyfluthrin, chlorothalonil, 2,4-D, MCPP-p, dicamba, imidacloprid, and carfentrazone. This season, three applications of the reduced-risk fungicide azoxystrobin were made. Analyses of these samples are in progress.

This study also evaluates best management practices for reducing golfer exposure to reduced-risk turfgrass pesticides. While many "standard" pesticides have been removed from use, new reduced-risk pesticides have been added to the IPM practitioner's toolbox. To date, there is no dosimetry or biomonitoring data on these reduced-risk pesticides, which exhibit low mammalian and environmental toxicity, low potential for ground water contamination, low pest resistance potential, and are compatible with IPM.

To determine precisely how much of the environmental residues is 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). This work is being done in cooperation with the New England Regional Turfgrass Foundation.

To determine precisely how much of the environmental residues is actually transferred to golfers during a round of golf, volunteers are used for 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).

A transfer factor of 1,800 has been calculated for carfentrazone. 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 . This season (2008) we determined exposure in 24 rounds of golf following application of azoxystrobin without post-application irrigation.

Hazard quotients (HQs) less than or equal to 1.0 indicate that the exposure resulted in a pesticide dose at which adverse effects are unlikely. To date, HQs determined for chlorpyrifos, carbaryl, cyfluthrin, 2,4-D, dicamba, MCPP, chlorothalonil, imidacloprid, and carfentrazone have been 20- to 1.25 million-fold below 1.0, indicating safe exposure levels using the EPA Hazard Quotient criteria.

The hazard quotient calculated for carfentrazone was 0.0000008, 1.25-million fold lower than a hazard quotient of 1.0. This HQ was significantly lower than those calculated for 2,4-D, MCPP, and dicamba (0.001 - 0.01). It is important to note that carfentrazone is considered a reduced-risk replacement for these phenoxy acid herbicides. The TF model will still allow us to calculate a hazard quotient in pesticides that are not amenable to biomonitoring.

Summary Points

- Researchers have evaluated exposure in 24 rounds of golf following the application of azoxystrobin (2008) and will compare this with future results from halofenozide (2009) and with those results of previous experiments on chlorpyrifos, cyfluthrin, carbaryl, chlorothalonil, 2,4-D, MCPP-p, dicamba, imidacloprid, and carfentrazone.
- Determination of golfer exposure to reduced-risk pesticides will provide a novel dataset for these IPM-friendly compounds.