USGA Green Section Research

Mobility and Persistance of Turfgrass Pesticides in a USGA Green

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The use of reduced irrigation for one week following fenamiphos application was studied as a means of reducing fenamiphos and its metabolites leaching from a USGA green in south Florida. Leaching was reduced during the period of limited irrigation, but total leaching was equivalent for low and high irrigation treatments over a longer period that included plentiful irrigation and rainfall. It appeared that the fenamiphos and its metabolites that were not leached when irrigation was restricted eventually leached when excessive irrigation and rainfall occurred.

The percolate collection system in the USGA green at the Ft. Lauderdale Research and Education Center was expanded to include 12 lysimeters. This will permit greater numbers of replications in studies involving two or more treatments, which is very important for pesticide studies.

During excavation, it was noted that seven cm of topdressing had accumulated on the green since the lysimeters were first installed. This layer appeared to hold more water than the underlying media. It contained somewhat higher percentages of the finer sand sizes. It also had considerably more organic matter than either the original rooting mix or than the topdressing material. No movement of rootzone mix into the coarse sand layer, or of coarse sand into the underlying gravel, was observed during excavation for the newly added lysimeters.

Volatilization of the organophosphate pesticides isazofos, chlorpyrifos, and fenamiphos was measured in two studies. Volatilization was greatest for chlorpyrifos and least for fenamiphos. It was less for an application that was followed by rainfall than for one followed by dry weather. Isazofos volatilization amounted to 1 and 9 percent of that applied for the two rainfall situations, respectively.

Evaluation of Management Factors Affecting Volatile Loss and Dislodgeable Foliar Residues.

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Volatilization can be a major route of pesticide loss following application to turfgrass. Consequently, a significant portion of applied pesticide might be available for human exposure via volatile and dislodgeable residues. In previous USGA-funded research carried out by this laboratory, volatile and dislodgeable residues were determined following application of triadimefon, MCPP, trichlorfon, and isazofos to an established plot of Penncross creeping bentgrass. For each application, a ten-meter radius plot was sprayed and the Theoretical Profile Shape (TPS) method was used to estimate volatile flux. Dislodgeable residues were concurrently determined by wiping treated turfgrass with a water dampened piece of cheesecloth.

Less than eight percent of the total applied triadimefon was measured as volatile residues with nearly all volatilization loss occurring within five to seven days of application. Diurnal patterns of triadimefon volatilization were evident with volatilization greater at mid-day than morning and late afternoon.

Less than one percent of the total applied MCPP was measured as volatilie residue. Volatile MCPP residues decreased over time to non-detectable levels by Day 5. Both triadimefon and MCPP dislodgeable residues were greatest on Day 1 following application and dissipated over time. By Day 5, triadimefon dislodgeable residues decreased to 0.04 percent of the initial residue level immediately following application and MCPP dislodgeable residues were non-detectable.

For trichlorfon and isazafos applications, less than 12 percent of applied insecticide was lost as measured volatile residues during the experimental sampling periods. Volatile loss declined in a diphasic pattern with most loss occurring within five to seven days of application. Irrigation greatly reduced initial volatile and dislodgeable residues. Subsequent volatile and dislodgeable residues, however, decreased substantially on Days 2 and 3 compared with residue levels in the absence of irrigation.

Trichlorfon dislodgeable residues never exceeded one percent of applied compound in the absence of irrigation. In contrast, with irrigation dislodgeable residues of trichlorfon and isazofos were never greater than 0.5 percent of applied compound. Irrigation increased the transformation of trichlorfon to DDVP, a more toxic insecticide.

Inhalation and dermal exposures were estimated using measured air concentrations and dislodgeable residues, respectively. Hazard quotients (HQs) were calculated for both volatile and dislodgeable residues of each pesticide. An HQ less than one indicated that the residue level is below a concentration that might reasonably be expected to cause adverse effects in humans.

Triadimefon and MCPP volatile and dislodgeable residues resulted in HQs below 1.0 throughout the entire 15-day experimental period, indicating that exposures were below any level expected to cause adverse health effects.

We have determined the critical US EPA Office of Pesticide Programs Reference Dose above which no turfgrass pesticide will result in dermal HQ greater than 1.0 to be between 0.005 to 0.013.

We have collected appropriate weather data with this residue set. With the help of Dr. D. Heath at Cornell University, we are modeling this data into a temperature-dependent algorithm that will determine the critical surface temperature below which no volatile turfgrass pesticide will result in an inhalation HQ greater than 1.0.

In summary, we have shown that organophosphate insecticides that possess high toxicity and volatility can result in exposure situations that cannot be deemed completely safe as judged by the US EPA Hazard Quotient determination.

In order to more accurately predict the health implications of pesticide exposure to golfers, a relevant study measuring exposure during play needs to be carried out. With more accurate exposure estimates, it is our belief that the true exposure to pesticides on a golf course will be found to be less than those reported in our research.

Evaluation of Best Management Practices To Protect Surface Water From Pesticides and Fertilizer Applied to Bermudagrass Fairways.

By Dr. James H. Baird, Oklahoma State University

In 1995, research was conducted to evaluate the influence of buffer strips on pesticide and nutrient runoff from bermudagrass turf. In 1996, two experiments were conducted to further examine the effects of buffer-strip mowing height and length on pesticide and nutrient runoff from bermudagrass turf on a six percent slope. Buffer strips were mowed at three heights, 0.5, 1.5, and 3.0 inches.

In the length experiment, the area receiving pesticides and fertilizer was upslope from the buffer and was mowed at 0.5 inch. Urea, sulfur-coated urea, triple superphosphate, chlorpyrifos, 2,4-D, mecoprop and dicamba were applied at recommended rates to each experiment. A portable rainfall simulator was used to apply a precipitation rate of 2.5 inches per hour for 75 minutes within 24 hours after chemical application.

In the mowing height experiment, the three-inch buffer was most effective in delaying start of runoff and decreasing total runoff volume. Pesticide and nutrient losses to surface runoff volume were as great as 11 percent and ten percent, respectively, from the 1.5 inch buffer strips. Overall, there appeared to be no advantage in mowing the buffer strip at either 0.5 or 1.5 inches in terms of reducing pesticide and nutrient runoff. The positive effect of the three-inch buffer would most likely be overcome by higher soil moisture and runoff conditions during periods of rainfall.

Pesticide and nutrient loss to surface runoff was less than seven percent in the buffer-strip length experiment. The differences in surface runoff losses between the two experiments were most likely due to differences in soil moisture at specific locations. Overall, data from this experiment reaffirmed that buffer strips are effective in reducing pesticides and nutrient runoff. In addition, these data might be very useful for extrapolating effective buffer strip lengths for testing on larger watersheds.

A reduction in nitrogen found in surface runoff occurred for SCU applied in the buffer strip mowing height study. However, these results might have been caused by differences in soil moisture between testing locations.

Results of the experiments confirm that use of buffer strip, application of pesticides and fertilizers with lower water solubilities, and avoidance of pesticide and nutrient application when the soil is saturated, all help to reduce chemical loss in surface runoff from turf.

Cultural Control, Risk Assessment, And Environmentally Responsible Management of White Grubs And Cutworms

By Dr. Daniel Potter, University of Kentucky

Research on the biology of black cutworms revealed ways that this pest can be more effectively managed. Nearly all of the eggs laid on creeping bentgrass putting greens are glued to the tips of grass blades, where they are removed by daily mowing and disposal of clippings. Most eggs can survive passage through the mower blades and will later hatch. We advise golf course superintendents to dispose of clippings well away from greens and tees.

Cutworm moths also lay eggs on higher-mowed turf in fairways and roughs. But, most eggs are laid lower down on grass plants where they would not be removed by mowing. Thus, reservoir populations can develop in high grass surrounding greens and tees.

Cutworms are most active on putting greens between midnight and one hour before sunrise. Pesticide treatments are best applied toward evening. Contrary to expectation, cutworms were not attracted to aerified bentgrass. Sand topdressing seems to partially deter cutworms.

Mowing an hour before dawn might provide substantial control by shredding. Since cutworms can crawl as far as 70 feet in a single night, we suggest a 30-foot buffer zone be treated around putting greens.

Perennial ryegrass and tall fescue (without endophyte) were found to be as suitable for cutworms as creeping bentgrass, but Kentucky bluegrass was highly unsuitable as food. The use of Kentucky bluegrass around greens and tees, coupled with daily mowing and clipping removal can improve control.

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