Pesticide and Nutrient Fate

Introduction

Use of chemicals for the control of turfgrass pests, in conjunction with other cultural practices, has had a tremendous effect on the quality of turfgrass grown for golf courses and lawns. Chemical control of pests is only one of the several techniques used on golf courses to sustain turfgrass quality and reduce labor and energy costs.

Despite the obvious cultural and economic benefits, conflicts have developed over pesticide and fertilizer use in relation to environmental quality issues. Chemical residues have been associated with adverse environmental and potential human health effects including: 1) implication of some pesticides as potential human carcinogens, 2) long-term contamination of soils with persistent chemicals, 3) contamination of water resources, and 4) effects on non-target organisms.

Although the existing research results on the fate of chemicals applied to turfgrass is encouraging, much of this available scientific information has been derived from agricultural rather than turf systems or was conducted under a limited set of conditions (i.e., climates, soils, irrigation, turfgrass species, etc.), leaving room for uncertainty.

Based on these concerns, a three-year research program to investigate pressing pesticide and nutrient fate issues specifically relevant to golf course and turfgrass systems was implemented. The overall objective of the research is to understand the mass balance, fate and persistence of pesticides and nutrients applied to turfgrass systems.

These studies cover a wide range of golf course management factors, climates, and sampling methods which include:

- Putting green soil mixtures (sand, sand/peat) and fairway soil textural classes (sand, loam, silt loam)
- Thatch development
- Soil profile sampling depths
- Turfgrass species maintained under golf course conditions
- Irrigation regimes

This section first describes the specific objectives and procedures of each pesticide and nutrient fate research project. Afterwards, the preliminary results for these projects are summarized, in general terms, to note the significance of their findings. The summary includes preliminary results concerning the subsurface and surface loss of nitrogen and phosphorous, and the mobility and persistance of pesticides.

Cornell University

Mass Balance Assessment of Pesticides and Nutrients Applied to Golf Turf - Dr. A. Martin Petrovic

The objective of this project is to more fully understand the fate of pesticides and fertilizers applied to golf turf evaluated over a wide range of conditions. These experiments are being conducted at the ARESTS facility (Automated Rainfall Exclusion System for Turfgrass Studies) which is composed of 3.2 m x 3.2 m (10 ft. x 10 ft.) draining lysimeters (i.e., devices for the collection of water percolating through the soil), a rainout shelter, and an irrigation and drainage collection system. Factors evaluated are three soil textures (acid sand, sandy loam and silt loam) and two simulated growing season precipitation patterns (normal and wetter-than-normal). In this case, rainfall patterns for 1950 and 1917 were used for normal and wet, respectively.

Evaluated, thus far in this study, were applications of mecoprop, triadimefon, and trichlorfon applied to a simulated creeping bentgrass fairway. A ^{15}N labeled urea/methylene urea fertilizer containing phosphorus also was applied and will be monitored during the research project. Measurements taken include clipping yields and leachate from all or some of the lysimeters. The leachate samples are being analyzed for the concentration of nitrate, ammonium, phosphate, mecoprop, triadimefon, and trichlorfon.

Michigan State University

Groundwater Contamination Potential of Pesticides and Fertilizers Used on the Golf Course - Dr. Bruce E. Branham

This project is designed to examine the leaching potential of nitrogen, phosphorus, and pesticides under field conditions. Four lysimeters have been installed at the Hancock Turfgrass Research Center on the Michigan State University Campus. These lysimeters are 1 m^2 (10 ft^2) in surface area and are 1.2 m (4 ft.) deep. The soil within the lysimeters are intact cores that were not disturbed during the construction of the lysimeter. Data from these lysimeters will reflect conditions that oc-

cur naturally in the field, and the results will give a clear picture of the leaching potential of the soil (Owosso sandy loam) used in this study.

The project consists of three separate areas. First, the amount of nitrate leaching from late-fall versus early spring applications of ^{15}N labeled urea is being investigated. This study also will examine the fate of nitrogen over a three year period and will focus on the cycling and forms of nitrogen in the soil. Second, five fungicides, two herbicides, and one insecticide will be applied to the lysimeters and leachate will be tested for the presence of these pesticides over the next three years.

The last objective of the study is to examine the mobility of phosphorus in putting green soil mixes. Phosphorus has little mobility in soils with appreciable clay content; however, movement can occur in soils that are mostly sand. This study involves collecting samples from recently constructed greens throughout the United States, and will test these mixes for phosphorus adsorption capacity. Also, phosphorus mobility on pure sand greens will be examined at the Hancock Turfgrass Research Center.

University of California, Riverside

The Fate of Pesticides and Fertilizers in a Turfgrass Environment - Dr. Marylynn V. Yates

The purpose of this project is to study the fate of pesticides and fertilizers applied to turfgrass in an environment which closely resembles golf course conditions in southern California. The goal is to obtain information on management practices that will result in healthy, high quality turfgrass while minimizing the potential for detrimental environmental impacts.

The specific objectives of the project are to: 1) compare the leaching characteristics of pesticides and fertilizers applied to creeping bentgrass greens and bermudagrass fairways; 2) study the effects of soil type and irrigation regime on the leaching of pesticides, nitrates and phosphorus; 3) compare the leaching and volatilization characteristics of nitrates from different fertilizers; 4) measure the volatilization rate of pesticides from turfgrasses into the atmosphere as a function of time after application; and 5) monitor the effects of different irrigation regimes, fertilizers, and soil types on turfgrass quality.

The research site consists of 36 plots, each measuring 3.7 m x 3.7 m (12 ft. x 12 ft.). The fairway area consists of 24 plots, 12 each of two different soil types that have been located randomly in the fairway area. The soil mixture used in the putting green area is a Caltega IV green sand containing 10 percent sphagnum peat. Two different soils are being used in the fairway area to represent the ends of the spectrum in terms of leaching potential, while still being representative of actual golf course soils. One of these is a fine sandy loam, the native soil at the site. The other soil is a fine sand that has been brought to the site.

Irrigation is controlled electronically and scheduling is determined based on the evapotranspiration requirements of the turfgrass. All turfgrass-soil type combinations will be subjected to two irrigation regimes: 100 percent crop evapotranspiration (ET_c) and 130 percent ET_c.

A lysimeter assembly, consisting of five metal cylinders, was placed in the center of each of the 36 plots. Gravel was placed in the bottom of each lysimeter for drainage. The appropriate soil was then added to the lysimeters. To ensure uniform soil conditions, the soil was hand packed to the same bulk density in each of the barrels.

University of Nebraska
Iowa State University

Pesticide and Fertilizer Fate in Turfgrasses Managed Under Golf Course Conditions in the Midwestern Region - Dr. Garald E. Horst and Dr. Nick E. Christians

The objective of this research is to determine the influence of pesticide, fertilizer and irrigation management practices on the persistence and mobility of nitrogen and selected pesticides in turfgrass systems. Soil columns were sampled from the field to monitor pesticide and nitrogen movement. Intact, undisturbed soil columns also are removed from the field and grown in the greenhouse under conditions which simulate the field turf-soil environment. The greenhouse soil columns allow measurement of nitrogen and pesticides in leachate to complete the balance-sheet of their fate in the turfgrass system.

Research sites with established stands of Kentucky bluegrass were selected at the John Seaton Anderson Turfgrass Research Facility near Mead, Nebraska, and at the Iowa State University Horticulture Farm, Ames, Iowa. The experimental areas were treated with recommended rates of urea fertilizer, Trimec® (2,4-D, mecoprop and dicamba) and pendimethalin herbicides, isazofos and chlor-