TITLE: Groundwater Contamination Potential of Pesticides and Fertilizers Used on the Golf Course

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CLIMATIC REGION: Cool humid
USGA REGION: Great Lakes

1991 EXECUTIVE SUMMARY

PROJECT TITLE: GROUNDWATER CONTAMINATION POTENTIAL OF PESTICIDES AND FERTILIZERS USED ON THE GOLF COURSE

PRINCIPAL INVESTIGATORS: Bruce Branham, Paul Rieke, Matt Zabik, Eldor Paul, and Boyd Ellis

This project is designed to examine the leaching potential of nitrogen, phosphorus, and pesticides under realistic field conditions. Four lysimeters, devices for the collection of soil water, have been installed at the Hancock Turfgrass Research Center (HTRC) on the Michigan State University Campus. These lysimeters are 1 m^2 in surface area and 1.2 m deep. The soil within the lysimeters are intact cores that were not disturbed during the construction of the lysimeter. We believe that the data from these lysimeters will reflect conditions that occur naturally in the field and that the data will give a clear picture of leaching potential for the soil (Owosso sandy loam) used in this study.

The project consists of three separate areas. First, the leaching of nitrate from late-fall versus early spring applications will be studied using ^{15}N labeled urea. This study will also examine the fate of nitrogen over a three year period and will focus on the cycling and forms of nitrogen in the soil. As a second approach to the study, pesticides will be applied to the lysimeters and the leachate tested for the presence of these pesticides over the next three years. A total of five fungicides, two herbicides, and one insecticide will be applied. In August the insecticide Triumph and the fungicide Daconil were applied to the lysimeters and in September the herbicides 2,4-D and MCPP were applied. The other four fungicides will be applied in 1992. The other area of the study is to examine the mobility of phosphorus in greens soil mixes. Phosphorus has little mobility in soils with appreciable clay content, however, movement can occur in soils that are mostly sand. This study will collect samples from recently constructed greens around the US and test these mixes for phosphorus adsorption capacity. Also, phosphorus mobility on pure sand greens will be examined at the HTRC.

Results from our first summer of monitoring are not available at this time due to the intensive nature of the laboratory analysis required to determine ^{15}N quantities. Data on the quantity of leachate is interesting since it demonstrates that under periods of high ET demand, little leaching occurs. From May 1 through August 28, the lysimeters received a total of 60 cm of rainfall plus irrigation. However, only 4 cm of leachate were collected from the lysimeters. From August 29 through September 16, an additional 8 cm of rainfall plus irrigation were received while the lysimeters leached 4.8 cm of water. Thus as ET demand slackens the soil moisture level throughout the whole core rises and rain or irrigation will cause leaching. These data point out the importance of irrigation management to reduce the potential for leaching. Data will be available in 1992 on the ^{15}N and pesticide content of the leachate as well as data on the cycling and movement of ^{15}N through soil.

1991 FINAL REPORT

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STATUS OF RESEARCH

This project is designed to give realistic data on leaching of pesticides and nitrogen through turfgrass systems in the field. In addition, data on the potential for movement of phosphorus through greens mixes is also being studied. Our approach to examining pesticide and nitrate leaching is to use large, undisturbed soil cores and to collect all water draining from these cores during the entire experiment. The lysimeters we are using are constructed from stainless steel and are 1 m^2 in surface area and 1.2 m deep. The soils within these lysimeters are undisturbed cores that were captured within the lysimeter prior to installing the base of the lysimeter. It is our contention that these lysimeters will provide realistic data on leaching of pesticides and nutrients.

The first treatments to the lysimeters were initiated in April of 1991. Two lysimeters were treated with 0.8 lbs N/M as ^{15}N labeled urea on April 20th. The nitrogen fertilization schedule calls for these lysimeters to receive 4 lbsN/M/YR in 5 equally spaced applications of 0.8 lbs N/M. As per the suggestion of the USGA research committee, two additional lysimeters were installed in the spring and summer of 1991. These two additional monolith lysimeters, the cost of construction borne by MSU, will permit us to have two treatments with two replications. The second treatment will be a late-fall application of ^{15}N labelled urea which will allow us to compare the fate of N applied at the traditional early spring time frame versus the more popular late-fall timing. The late-fall application will be made on or around November 5th,1991.

Leachate, clipping, and soil samples have been collected throughout the summer. Leachate samples were collected whenever more than 4 L of leachate had accumulated. Clippings were collected weekly. Soil cores (20 cm diameter by 60 cm deep) were collected twice this past summer and will be collected five more times during the course of the study. These soil cores are termed microplots to denote the fact that they are treated exactly the same as the main lysimeters including treatment with ^{15}N labeled urea. The cores are removed four times during the first year of treatment, two times the second year of treatment, and once during the third year of treatment. Laboratory analyses are currently being conducted on the various samples and will take throughout the winter to complete. This initial data will be available for our May progress report.

Pesticide applications were initiated in the summer with an application of isazophos (trade name -Triumph) insecticide at a

rate of 1.5 floz/M on August 12th. The fungicide chlorothalonil (trade name - Daconil) was applied on August 21st at a rate of 6 floz/M and the herbicide mixture Trimec was applied on September 17th at a rate of 4 pts/A. Leachate samples have been collected, subsampled, and are currently being analyzed. Applications scheduled for 1992 include Rubigan at 2 oz/M on May 1, 1992; Bayleton at 2 oz/M on June 1, 1992; Banner at 2 oz/M on July 1, 1992; and Subdue at 2 oz/M on August 1, 1992.

An additional area of study is the effect of high sand content greens mixes on mobility of phosphorus. This part of the study utilizes two approaches to study P mobility. The first approach involves monitoring previously constructed greens at the Hancock Turfgrass Research Center (HTRC) for P mobility. Soil samples have been taken from the greens at the HTRC to determine initial P status. Phosphorus treatments will be applied in November and vertical mobility followed by core sampling of the greens area. The second approach entails collecting soil samples from recently constructed greens within and outside the State of Michigan. Samples from recently constructed golf courses have been taken from five of the ten sites in Michigan with the remaining sites to be sampled in November. Arrangements are being made with the USGA staff to assist in collecting samples from outside the State of Michigan. These soil samples will be used to determine, in the laboratory, the P adsorption characteristics of typical greens mixes and determine if some types of sands currently being used do not have adequate P absorption capacity.

The data we have collected so far concerns the amount of leachate moving through the lysimeters at the HTRC. This data is shown in Table 1 for the cumulative amounts of rainfall plus irrigation and for leachate collected from the two lysimeters through October of 1991. The attached figure graphically shows the data for leachate and rainfall plus irrigation on an event basis(ie. non-cumulative).

While the data will be much more interesting when nitrate and $^{15}NO_3$ contents are determined, the leaching data itself provides some interesting insight into the potential for groundwater contamination from golf course practices. First, and most significantly, almost no leaching occurred from May through the middle of August. On August 29, about 1.15 cm of leachate were collected immediately followed by 0.6 cm on August 30 and 3.15 cm on September 3 for a total of 4.9 cm of leachate in one week. That represents the same amount of leachate as was collected from May 1 until August 29. Thus the plant community is using large amounts of water and even significant rain events (a total of 42 cm of rain between May 17 and August 17) failed to generate any significant leaching during that time. It was only when ET rates started to decline in August due to cool temperatures that soil moisture levels increased to the point where rainfall would cause significant leaching.

This points out the importance of water management in reducing leaching during the summer. Many golf course superintendents have been accused of over-watering and if a superintendent does over-water this will lead to a soil profile close to field capacity, which would greatly increase the chance of having significant leaching events during the summer.

Table 1. Cumulative combined rainfall and irrigation and leachate collected from lysimeters at the Hancock Turfgrass Research Center during 1991.

DATE	Rainfall + Irrigation	lysimeter # 1	lysimeter # 2
	All values in cm of water		
5/1	11.10	0.81	0.91
5/17	14.00	1.31	1.58
6/12	25.43	2.27	2.33
7/22	38.21	2.97	2.36
8/17	53.20	3.89	2.68
8/23	58.15	4.20	3.18
8/29	61.27	5.40	4.28
8/30	61.79	5.94	4.92
9/3	65.72	8.88	8.29
9/16	68.32	9.32	8.95
10/22	76.67	9.47	9.76

DRAINAGE AND INPUT WATER
HTRC LYSIMETERS 1 AND 2, 1991