FATE OF NITROGEN AND PESTICIDES APPLIED TO A KENTUCKY BLUEGRASS TURF

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Experiments were initiated in 1991 at the Hancock Turfgrass Research Center to investigate the fate of fertilizer nitrogen and leaching potential of several pesticides commonly applied to turfgrass. The objectives of these studies were to construct a mass balance for fertilizer nitrogen, compare leaching potential of nitrogen applied according to two different schedules, and examine the leaching potential of several commonly used pesticides.

MATERIALS AND METHODS

Four intact soil monolith lysimeters were constructed for the purposes of these experiments. The lysimeters consist of undisturbed cores of soil 115 cm (45 inches) in diameter and 122 cm (48 inches) in depth encased in stainless steel, with adjacent below-ground access for leachate sampling. Microplots of PVC pipe 20 cm (8 inches) in diameter and 60 cm (24 inches) deep were installed nearby for soil sampling so that the intact lysimeter cores would remain undisturbed.

Nitrogen fate

Two experimental treatments were initiated in 1991. Each treatment received a total of 196 kg N/ha/yr (4.0 lb N/1000 ft^2) as urea applied in five equal applications of 39.2 kg N/ha (0.8 lb N/M). Application schedules for the "Spring" and "Fall" treatments are given in Table 1.

Table 1. Nitrogen fertility schedule for HTRC lysimeters for Spring and Fall N treatments.

SPRING	FALL
April 26	
June 4	June 4
July 12	July 12
August 19	August 19
September 27	September 27
	November 8

The late Fall application (November) has been recommended in recent years for favorable turf response in the Spring, but concern has been raised over increased leaching potential of fertilizer nitrogen applied at this time. April and November applications were made with ^{15}N-labelled urea. This single application for each treatment can be distinguished from all other N in the environment, including other fertilizer N, based on its atomic weight. This allows for more direct comparisons of the late Fall application with the Spring application. Leachate was collected approximately every seven to ten days and analyzed. Soil samples were collected four times per year. Nitrogen in the soil was partitioned into inorganic N, root N, microbial biomass N, non-living organic N, and thatch N. Clippings were collected approximately weekly and analyzed for nitrogen. By these means fertilizer N in each pool could be calculated in order to construct the balance sheet.

Pesticide mobility

Eight commonly used pesticides were studied for potential mobility (Table 2). Each was applied one time at the specified rate to each of two lysimeters. In addition, chlorothalonil and metalaxyl were applied with repeat applications to the two remaining lysimeters. Metalaxyl was applied three times at 21 day intervals, and chlorothalonil was applied four times at 14 day intervals. Leachate samples were analyzed for each of these pesticides.

Table 2. Pesticides and rates of application for pesticide mobility study.

Product	Active Ingredient	Application Rate	Rate a.i. kg/ha
Triumph 4E	isazophos	1.5 oz/M	2.24
Trimec Classic		4 pt/A	
	2,4-D		1.14
	dicamba		0.12
Daconil 2787F	chlorothalonil	6 oz/M	9.56
Rubigan	fenarimol	2 oz/M	0.76
Banner	propiconazole	2 oz/M	0.64
Bayleton	triadimefon	2 oz/m	1.53
Subdue	metalaxyl	2 oz/M	1.53

RESULTS AND DISCUSSION

Nitrogen fate

Data presented is limited to inorganic nitrogen content of soil and volume and nitrogen content of leachate, information which indicated the leaching potential for nitrogen under the two fertility treatments. Mass balance data is not presented due to limited ^{15}N analysis.

Tables 3, 4, and 5 show concentration of inorganic nitrogen in the soil by depth for samples taken May 14 and November 26, 1991 and May 20, 1992, respectively. Nitrogen concentration was higher for the Spring treatment in the upper 5 cm (2 inches) on the first sampling date (Table 3). This was expected since the Fall treatment had not yet received fertilizer. In November, soil N levels were similar for the two treatments throughout the profile (Table 4). The fact that soil N in the Fall treatment was not higher than the Spring treatment, which had not been fertilized since late September, may indicate efficient uptake of the late Fall applied N. In May 1992 (Table 5) soil N levels were again similar between treatments and were lower than in the previous Spring. This may indicate efficient mining of fertilizer and other inorganic soil nitrogen during the Spring green-up period.

Table 3. Inorganic nitrogen concentration in soil, sampled May 14 1991.

Depth	Treatment	
cm	Spring	Fall
	ug N/g soil	
0 - 5	28.5	18.3 *
5 - 10	17.0	18.0
10 - 20	15.2	11.9
20 - 40	6.1	6.8
40 - 60	3.7	6.2
60 - 100	4.4	3.8

* Significantly different at P = 0.05.

Table 4. Inorganic nitrogen concentration in soil, sampled November 26 1991.

Depth	Treatment	
cm	Spring	Fall
	ug N/g soil	
0 - 5	27.5	30.8
5 - 10	19.3	17.2
10 - 20	15.8	16.6
20 - 40	8.7	10.2
40 - 60	4.3	6.1 *
60 - 100	3.5	5.3

* Significantly different at P = 0.05.

Table 5. Inorganic nitrogen concentration in soil, sampled May 20 1992.

Depth	Treatment	
cm	Spring	Fall
	ug N/g soil	
0 - 5	10.6	10.5
5 - 10	6.9	6.5
10 - 20	5.9	4.9
20 - 40	2.3	2.5
40 - 60	3.0	2.7
60 - 100	3.4	2.3

Treatment means not significantly different.

Figures 1, 2, and 3 show cumulative volume of water and mass of nitrogen leached for each treatment. Figure 1, covering the period from May through October 1991 for the Spring treatment only (Fall treatment not yet applied), shows the pattern of nitrogen leaching followed that of water movement. This would be expected for a highly soluble compound such as nitrate or ammonium. There was an early pulse of nitrogen in the leachate, until about day 40. Figure 2 includes data for both treatments in the Winter of 1991–92 and Spring of 1992. The pattern of water movement is similar for both treatments, except for a period in mid to late December (days 215 through 230) when less water drained through the Fall fertilized soil. Late Fall fertilization may have led to maintenance of physiological activity in these plants, leading to greater plant water use and less leaching. This will be investigated in greater detail in the coming year. Nitrogen leaching for the Spring treatment levelled off after a slight pulse in December. Nitrogen leaching for the Fall treatment continued to climb throughout the Winter and into the Spring. Figure 3 shows water and nitrogen leaching for May through November 1992. Again the pattern of water flow is similar for the two treatments. There was a period in July and August (days 460 through 490) when drainage was less from Fall treated turf. Nitrogen leaching for the Spring treatment continued to rise only slightly, while that for the Fall treatment maintained a steady slope. Although this data indicates increased nitrogen leaching potential from the late Fall fertilized turf, the total amount of N leached was very small, less than 2% as compared to the total amount applied for the Fall treatment and less than 1% for the Spring treatment. Analysis of ^{15}N has been limited, but no ^{15}N had been detected in leachate as of February 1992. This indicates that nitrogen present in the leachate was from sources other than the applied fertilizer nitrogen, such as N in soil organic matter or fertilizer applied in years prior to the start of this experiment. Mean concentration of nitrogen as nitrate in the leachate over the entire course of the study was 0.31 parts per million for the Spring treatment and 0.69 parts per million for the Fall treatment. This was well below the EPA drinking water standard of 10 parts per million.

Pesticide mobility

Analyses have been conducted for samples collected through August 1992 for chlorothalonil and isazofos applied one time and for chlorothalonil applied multiple times. For chlorothalonil the lowest detectable concentration by the method used was 1 part per billion, and none of the samples contained measurable concentrations of the pesticide. The lowest limit of detection for isazofos was 7 parts per billion, and again none was detected in any of the leachate samples.

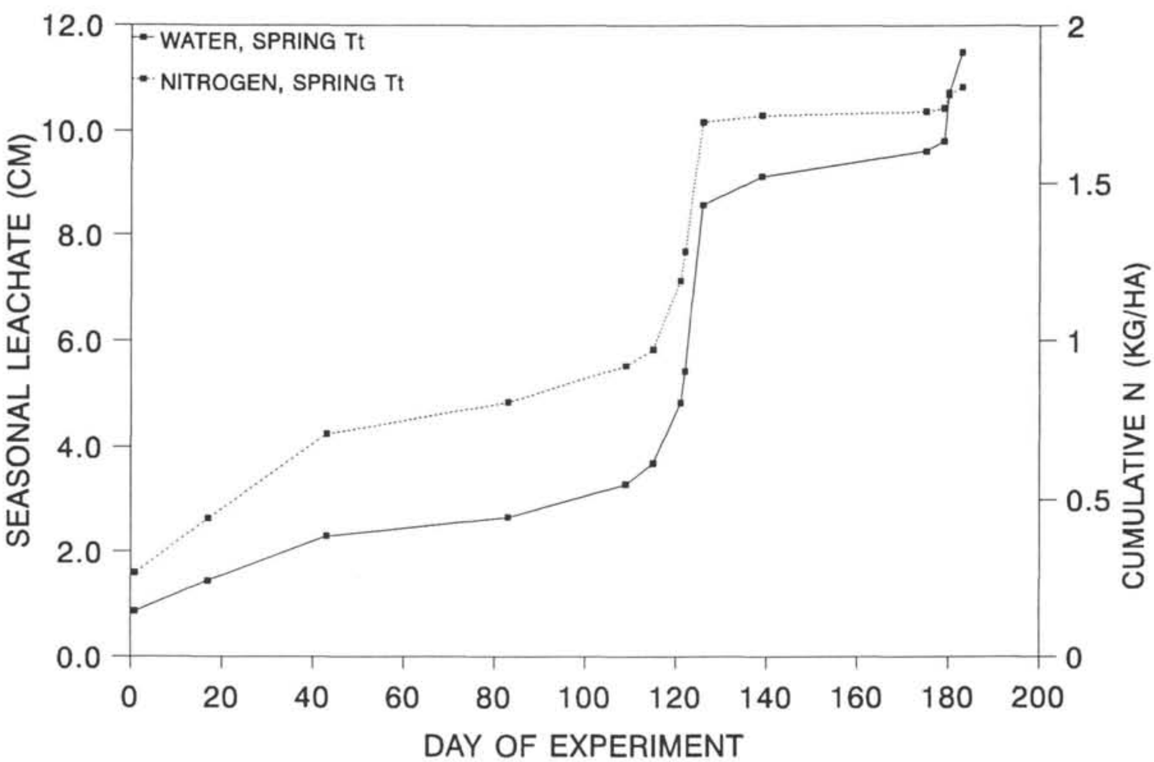

Figure 1. Seasonal cumulative water and cumulative nitrogen leached from lysimeters receiving Spring treatment for the period May through October 1991.

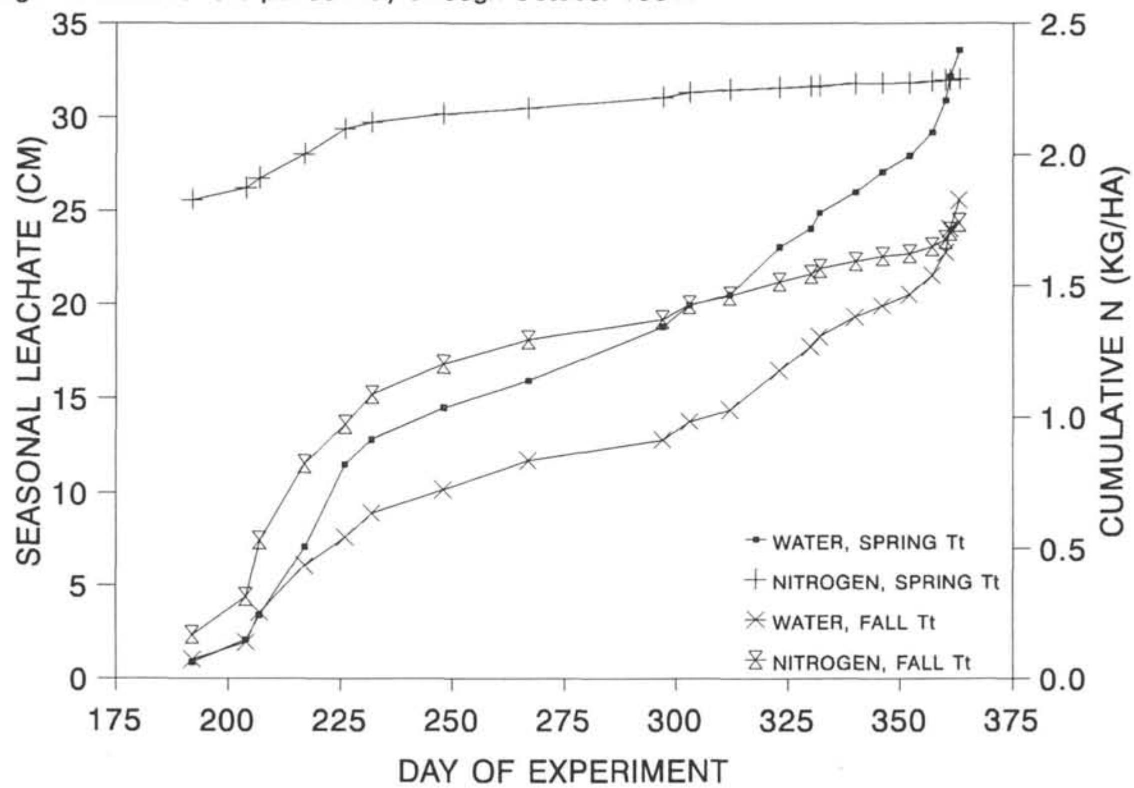

Figure 2. Seasonal cumulative water and cumulative nitrogen leached for the period November 1991 through April 1992.

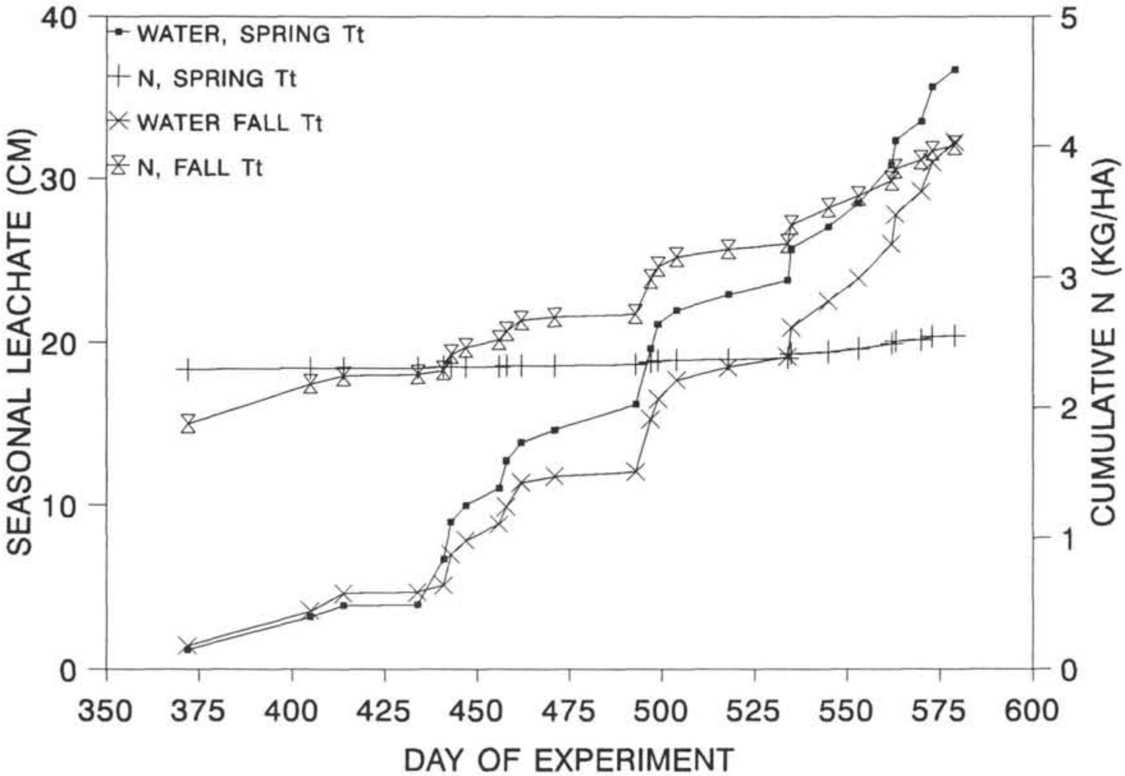

Figure 3. Seasonal cumulative water and cumulative nitrogen leached for the period May through November 1992.

SUMMARY

Leaching of nitrogen was detected under both fertility schedules, but the total amount of nitrogen leached was very small. Concentrations were well below the EPA drinking water standard. Of the pesticides analyzed thus far, none have been detected in the leachate samples.

The results presented here are encouraging, but they are only preliminary. The study will continue thorough 1993. A more complete picture of nitrogen and pesticide fate should be available at the time of completion of this work.