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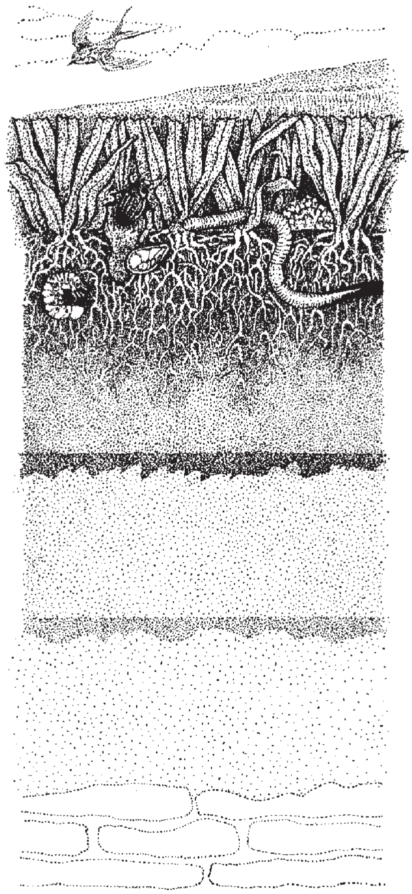

Turfgrass Pesticide Leaching Studies

Research recently conducted at the Cornell University Turfgrass Field Research Laboratory using the AREST facility (see CUTT V.2#4 for a description of AREST) investigated the potential of some commonly used turfgrass pesticides to leach from a two year old medium-maintenance Kentucky bluegrass turf. The results showed that the risk of pesticide leaching is generally small but that the risk is influenced by the combination of soil, pesticide and leaching event. The differences found indicated that decisions a turfgrass manager makes may affect whether or not pesticide leaching occurs. ■

This article is a summary of the work conducted by Nina Roth Borromeo under the guidance of Professor Marty Petrovic. The research partially fulfilled the requirements for Ms. Borromeo's Master of Science degree. Money for this research was provided partially by the New York State Turfgrass Association from their matching funds program.

Experimental Procedure

The three factors under investigation in this experiment were soil type, pesticide type and leaching event. The choices for each variable were made in order to reflect a range in the potential for leaching. All combinations of soil and leaching regimes were tested for all of the pesticides in the study.

A soil's leaching potential was expected to be reflected partially by soil texture and partially by the soil organic matter content. Finer textured soils and soils containing more organic matter were expected to have lower leaching potentials. The three soils used in the experiment were a fine textured Hudson silt loam, a medium textured Arkport sandy loam and a coarse textured medium sized sand (which met the USGA sand size specifications for putting green construction). The Hudson soil contained the most organic matter, 5.0 %, while the sand contained the least organic matter, 0.06 %. The Arkport soil contained 3.9 % organic matter.

The chemicals tested were carbaryl, chlorothalonil, and the diethylamine salts of 2,4-D and dicamba. Two factors which may influence the leaching potential of a specific pesticide are the solubility of the pesticide and the adsorption of the pesticide to soil particles. High solubilities and low adsorption ratings should indicate a greater risk for leaching. Table 1 lists some of the characteristics of the four pesticides tested. Therefore it would appear that dicamba and 2,4-D would be the most susceptible to leaching while chlorothalonil would be the least susceptible. The chemicals were applied to the plots at the recommended rates, so

continued on page 4

This Times

Turfgrass Pesticide Leaching Studies

continued from cover

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the amount of each pesticide applied varied. Eighteen grams of chlorothalonil, 11.0 g of carbaryl, 1.5 g of 2,4-D, and 0.56 g of dicamba were applied to each plot.

Two leaching regimes were under investigation: once per week (1X) and three times per week (3X). In both cases irrigation continued until leachate began to drain from the lysimeters. The leaching experiment began on the day prior to the pesticide applications when the plots were irrigated to saturate the soil. Two days after the pesticide applications leaching was initiated on the 3X plots. Seven days elapsed before the first leaching occurred on the 1X plots. The effects of two separate applications of pesticide were measured. The first test began on October 11, 1989 and the second test was started on July 24, 1990.

Table 1. Solubility and adsorption characteristics for the pesticides used in the leaching studies.

Pesticide	Water Solubility	Soil Adsorption
Dicamba	high	very limited
2,4-D	high	very limited
Carbaryl	slight	moderate
Chlorothalonil	insignificant	substantial

Table 2. Fraction of applied pesticide recovered in the leachate. Summer 1990 test.

Soil Type	Leaching Regime	Total Pesticide Leached Dicamba	2,4-D	Carbaryl
	(per week)	(% of total applied)		
Sand	1X	0.82	0.12	0.004
	3X	4.31	0.86	0.018
Arkport	1X	0.012	0.0014	0
	3X	0.004	0.0004	0
Hudson	1X	0.012	0.00015	0
	3X	0.04	0.005	0.0002

Results

One of the more striking trends from both tests was that the levels of pesticide leaching were generally small. The greatest amount of pesticide leached was 21 mg, which occurred twice, in both instances from the 3X sand plots. In the fall test 21 mg of 2,4-D was recovered in leachate (1.4 % of applied) and in the summer 21 mg of dicamba was recovered in leachate (4.3 % of applied). The greatest amount of pesticide leached from either the Hudson soil or the Arkport soil was 4 mg of carbaryl (0.04 % of applied) in the fall test from the Hudson 3X plot.

A second trend was that the recovery of pesticide in the leachate was related to the solubility of the pesticide and to the adsorption ratings of the pesticides. So, as a percentage of the pesticide applied, more dicamba was found in the leachate compared to 2,4-D, carbaryl or chlorothalonil. Table 2 presents data from the 1990 test; unfortunately chlorothalonil data was available only for the 1989 fall test. Very little of the applied carbaryl was found at all in any plots with recoveries ranging from 0.1 % to zero. In 1989 the percentage of chlorothalonil leached was much lower than for the other pesticides. The most recovered from any plot was 0.276 mg (0.0004 % of total applied) of material, in the leachate from the Hudson soil leached three times per week.

A third trend in the data was related to the leaching treatment and the relationship between the leaching regime and soil type. More pesticide was recovered in the leachate from the 3X sand and the 3X Hudson soil compared to the 1X leaching regime. Further, much more pesticide was leached from the sand than from the Hudson soil. In contrast, approximately the same amount of pesticide was leached from the Arkport soil under the two leaching conditions. If the comparison is made between the Hudson and Arkport soils then more pesticide was leached from the Hudson under the 3X treatment but the reverse appeared to hold true for the 1X leaching regime.

Fourth, the type of soil and the type of pesticide appeared to affect the length of time it took for the maximum concentration of a pesticide to leach through the soil. Data from the summer test indicated that most of the pesticide leached from the Hudson soil 3X treatment was leached after the first irrigation, two days after the application of material. Very little material was recovered in the rest of the study from the Hudson plots. In contrast the greatest concentrations of 2,4-D and dicamba leached through the 3X sand 12 days and 9 days after application respectively. The peak concentration of carbaryl was also recorded 9 days after the application of the pesticide. Peak concentrations of pesticide from the 1X sand occurred 15 days after treatment for all three chemicals.

An unexpected result of the experiment was that the maximum amount of leaching from the 3X Hudson soil plots occurred after the first irriga-

Scanning the Journals

continued from page 3

tion. It had been expected that the losses of pesticide in the leachate from the Hudson soil would have been small and slow to occur. One feature unique to the Hudson soil which may partially account for the rapid leaching was the presence of earthworms. Their burrows could provide channels for water carrying pesticides to leach rapidly from the soil. So, the potential for water to rapidly move to the drain lines combined with the short two day interval between the pesticide application and the first leaching event seemed to increase the risk for pesticide leaching. It is important to note that very little pesticide was found in the first leachate collected from the 1X plots. In this case the leaching event was seven days after the application of the pesticide. Apparently most of the pesticide became unavailable for leaching within seven days of being applied.

Summary

The results of this initial study seem to indicate that turfgrass areas are at a relatively low risk for pesticide leaching. Factors unique to the turfgrass system which may contribute to this lower risk are the high plant density and the presence of a thatch layer. Despite the general low risk though there are situations where leaching may be a potential problem, for example when soluble pesticides are applied to very sandy soils. By managing the selection of pesticide and the scheduling of irrigation the risk of leaching from turfgrass areas can be made even lower.

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The workers conclude that with an improved organic carrier allowing lower application rates, and further research into the biology of the disease and the antagonist, a sound theoretical basis for the biological control of dollar spot can be developed.

(From: D.M. Goodman and L.L. Burpee, 1991. Biological Control of Dollar Spot Disease of Creeping Bentgrass. Phytopathology 81:1438-1446.)

Identity of Pythium Root Rot Pathogen

Pythium root and crown rot has become an increasingly severe problem in the northeastern U.S. Attacking nearly all species of cool-season turfgrass, the disease is favored by prolonged wet conditions at both high and low temperatures. Symptoms include root and crown decay, reduced stand density and vigor, leaf chlorosis, and in severe infestations, total loss of stand. Because the foliar symptoms of the disease are fairly nondescript, and because many *Pythium* species can be isolated from diseased (as well as healthy) turf, the identity of the causative agent of Pythium root and crown rot has remained something of a mystery.

Cornell researchers Eric Nelson and Cheryl Craft conducted laboratory, growth chamber and field studies of 121 *Pythium* isolates recovered from golf courses mostly within the upstate N.Y. area. The isolates were tested on creeping bentgrass and perennial ryegrass at high and low temperatures. Five species of *Pythium* were found to be pathogens of creeping bentgrass at cool temperatures, and three were also pathogenic at high temperatures. Three of the five species also attacked perennial ryegrass. *Pythium graminicola* was the pathogen most commonly isolated from diseased turf, and more isolates of this species expressed virulence toward both grass species at high and low temperatures than any other *Pythium* tested. The researchers conclude that *P. graminicola* is the most common cause of Pythium root and crown rot in N.Y. turfgrass.

(From: E.B. Nelson and C.M. Craft, 1991. Identification and Comparative Pathogenicity of Pythium sp. from Roots and Crowns of Turfgrasses Exhibiting Symptoms of Root Rot. Phytopathology 81:1529-1536.)

Though the identity of the causative agent of Pythium root and crown rot has remained something of a mystery, the researchers conclude that* P. graminicola *is the most common cause in N.Y. turfgrass.