Pesticide Fate in Turf

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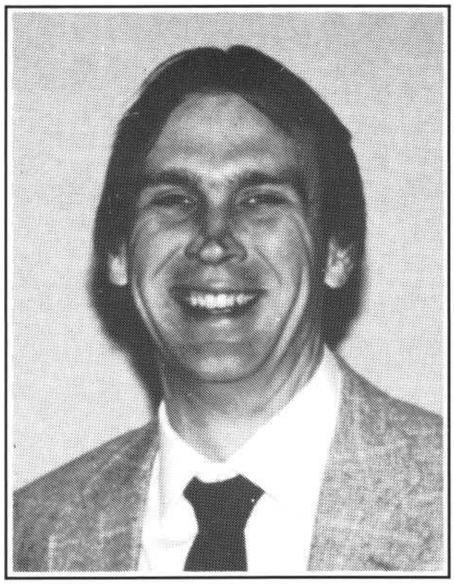
PART II



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Leaching is probably the biggest environmental concern facing the turf industry. The three factors mentioned in the December-January issue—soil absorption, persistence in soil, and water solubility—play a large role in determining the leaching potential of pesticides. Paraquat is very water soluble and has a long half-life in soil, but, because it is absorbed so strongly, it has never been detected in ground water and does not leach.

Another important factor in pesticide fate is runoff. Runoff occurs when the precipitation rate exceeds the infiltration rate of the soil. This often occurs during intense rainstorms. This is a serious concern of row crop agriculture where many of the pesticides are applied to bare soil which is not held in place by plants. When runoff occurs from row crops, not only can a pesticide be carried in the runoff, but water-insoluble pesticides can be carried on soil particles. In turf a different situation exists because the continuous plant cover holds the soil in place, preventing any soil erosion. Research by T. L. Watschke et al. (2) at Penn State University has shown that a well-maintained turf does an excellent job of reducing runoff, and that a turf improves soil permeability over time, allowing for greater infiltration. Watschke's data has shown that runoff from turfed sites is relatively rare and confined to intense rainoff events. Runoff can be considered a minor means of pesticide transport from turf in most situations.

Another means of transportation is volatilization. Volatilization is the transfer of a pesticide from a solid or liquid phase to a gas or vapor. The vapor can then be transported in the air and deposited off the application site. Volatilization is a concern when using broadleaf herbicides that are formulated as esters. Esters are generally volatile and can cause injury to non-target plants if volatilization occurs. The tendency for volatilization to occur depends primarily on the vapor pressure of the pesticide. Temperature and moisture also play important roles in determining the quantity of a pesticide that is volatilized.

Spray drift is technically not a pesticide fate process since it occurs before the pesticide is deposited on the soil or plant surface. However, spray drift is something that should be clearly understood since it is primarily determined by the spraying equipment used. Data in Table 2 shows the effects of droplet size on the length of time for the droplets to reach the ground. Droplets smaller than 100 *um* in diameter are considered aerosols and tend to settle to the ground very slowly. Droplets of these sizes should be avoided. Droplet size is determined by nozzle orifice size, spray pressure, and spray solution viscosity. The lawn care industry attempts to avoid spray drift by using the Chemlawn gun. This low-pressure sprayer has an average spray droplet size of 2200 *um*, well above the aerosol size limits. These drops are much heavier and fall rapidly to the turf.

The above discussion has centered on transportation processes which can result in the movement of pesticides from the site of application to undesirable sites such as ground water, surface water or non-target plants. We will now discuss the transformation processes which are generally viewed as beneficial since the result is the alteration and/or degradation of the pesticide molecule.

Unlike traditional row crops, all turf pesticide applications are made directly onto plant foliage. The turfgrass com-

Table 2: Effect of spray droplet size on spray drift.

Droplet Diameter	Time to Fall 10 Feet	Distance Traveled in 5 MPH Wind
1 *um*	28 hr.	29,050 ft.
10 *um*	17 min.	7,480, ft.
50 *um*	40 sec.	295 ft.
100 *um*	11 sec.	77 ft.
400 *um*	2 sec.	15 ft.
1000 *um*	1 sec.	7 ft.

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munity intercepts all pesticide applications and absorbs a fraction of each application. Plant absorption is one mechanism of pesticide transformation since most plants attempt to transform pesticides into more water soluble compounds through biochemical reactions. The extent of plant absorption of various pesticides by turfgrasses has not been well studied, and thus the magnitude of this pathway of pesticide removal is not known.

Another means of pesticide degradation that is difficult to quantify is photodecomposition, which is the degradation of compounds by light energy. This is difficult to study under natural conditions because it is difficult to tell whether degradation is due to light, microorganisms, volatility or other factors. The dinitroaniline herbicides (e.g. benefin, trifluralin, pendimethalin, and prodiamine) are known to be susceptible to photodecomposition; however, once they are watered into the soil, they are assumed to be safe from photodecomposition.

Microbial degradation is the most common means of pesticide degradation. Microorganisms are extremely efficient at degrading a wide variety of organic compounds. Microorganisms degrade pesticides by two different processes. Microorganisms which can use a pesticide as a food source are said to metabolize the pesticide. This method of degradation leads to a fairly rapid disappearance of the pesticide. Some microorganisms will alter the structure of the pesticide but are unable to gain any energy from the reaction. This process is called cometabolism. A pesticide degraded by a cometabolic process would tend to persist in the soil for a longer period of time. Microorganisms are extremely diverse and capable of degrading a wide range of organic compounds. Degradation by microorganisms is desirable because it usually results in the detoxification of the pesticide.

This discussion has attempted to identify the major pathways by which pesticides are transported or transformed in the environment. The issue of pesticides in ground or surface water and public exposure to pesticides will continue to be a major concern for our industry. Understanding the issues and concerns of pesticide use can only benefit our industry.

1) R. Doll and R. Peto. 1981. J. Natl. Cancer Inst. 66, 1192.

2) Watschke, T. L., S. Harrison, and G. Hamilton. 1988. Movement of nutrients and pesticides in runoff from turfed slopes. Agron. Absts. 157.

Former Researcher Joins GCM As Technical Editor

David M. Bishop has joined *Golf Course Management* (GCM) magazine as technical editor according to Clay Loyd, publications director for the Golf Course Superintendents Association of America (GCSAA).

GCM, the monthly journal for golf course superintendents and turfgrass managers, is the association's official publication.

Bishop comes to GCSAA from UAP Special Products in Fremont, Neb., where he served since 1985 as technical services manager/agronomist. Previously he spent five years with the University of Nebraska extension service specializing in turfgrass integrated pest management.

"GCSAA will be able to further expand the technical editorial content of *GCM* for the benefit of its readers, especially member golf course superintendents, with the addition of this newly created full-time position," Loyd said. "David Bishop brings to the magazine the background, contacts, skills and talent to help in that effort."

Bishop holds a master's degree in horticulture, with a minor in entomology, from the University of Nebraska, Lincoln. His research focus at Nebraska was the distribution and life cycle of the black turfgrass beetle, ataenius.

Colleen Smalter Pederson, GCSAA director of education, had been serving as technical editor in addition to her regular duties. Pederson will continue to concentrate on GCSAA's growing educational programs and other new program assignments.

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