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How Does Turf Influence Pesticide Dissipation?

Active thatch microbe populations can help reduce the risks of some pesticides.

BY B. E. BRANHAM AND D. S. GARDNER

(Opposite page) In turf, the pesticide application is made to a continuous layer of organic matter. The highly active microbe populations in thatch break down many pesticides much more quickly when applied to turf compared to applications to bare soil.

(Below) Turfgrass management is considered a close cousin of production agriculture. Research at the University of Illinois documents pesticide dissipation in turf versus bare soil.

It is no secret that production agriculture is receiving more and closer scrutiny because of concerns about pesticide and nutrient leaching that may be threatening some our nation's water resources. Like it or not, turfgrass management is considered a close cousin of production agriculture. Problems identified in production agriculture are assumed to apply to turf as well. So, it may be logical for government regulators, environmental activists, and concerned citizens to assume that highly maintained turfgrass sites also represent risks to the environment since turf, in many respects, is similar to production agriculture.

To gain a better understanding of this, the United States Golf Association funded research at the University of Illinois for three years to document pesticide dissipation in turf versus bare soil. These side-by-side studies were designed to determine the role of turfgrass and associated thatch on the fate of pesticides applied to turf.

WHY STUDY PESTICIDE DISSIPATION?

There were several reasons for undertaking these studies. First, many of the computer models used to predict pesticide leaching and movement have been developed for use in row crop agriculture, where the application is usually made to bare soil. In turf, the pesticide application is made to a continuous layer of organic matter, the turf, which may play a dominant role in the ultimate fate of these pesticides. Second, it may be possible to adjust these models to account for the effect of turf on pesticide fate.

Third, previous research indicated that some pesticides dissipate much faster when applied to turf than when applied to bare soil[1,2,3]. In most cases, however, these were not side-by-side comparisons, but separate studies conducted by different investigators at different locations. This leaves open the possibility that the increases in pesticide dissipation rates were not due totally to the presence of turf, but to some other factors.

At the University of Illinois, dissipation rates and leaching of five pesticides used in turf were examined. The focus was on newer pesticides, where little previous information on dissipation rates and leaching existed. Even for older pesticides, however, the amount of published information regarding their fate in turf is often quite limited or non-existent. The five pesticides chosen consisted of three fungicides, one insecticide, and one herbicide. These pesticides were selected to have a wide range of solubilities and half-lives that result in different leaching potentials.

IMMOBILE OR MODERATELY MOBILE PESTICIDES

After completing these experiments with five different pesticides, some trends began to emerge. The most illuminating finding is that pesticides classified as immobile or moderately mobile tend to have shorter half-lives in turf than in bare soil. The more rapid dissipation is due to the high microbial activity found in thatch.

For immobile pesticides, the faster rate of dissipation has few benefits from an environmental perspective, since these products tend not to leach anyway. However, decreasing soil or turf residence times could reduce the likelihood of pesticide runoff, since they will be present in the environment for shorter periods of time.

Preemergence herbicides, which need to remain present for several months to provide effective control, are often applied at higher rates in turf than in row crop agriculture. For example,

the rate for pendimethalin in soybean weed control is 0.75 lbs. a.i./acre, whereas in turf, rates of between 1.5 and 2.25 lbs. a.i./acre are used. For this group of pesticides, field experience has already shown that pesticides break down faster in turf than in bare soil.

The real value of turf appears in the case of pesticides that are moderately mobile. These products may leach to groundwater when conditions are favorable for leaching. These conditions include sandy soils, high rainfall or irrigation following pesticide application, or low soil organic matter content. In other cropping systems, the leaching potential of these pesticides does exist. In turf, it appears unlikely that these products would leach to a significant extent because of the capacity of turf to retain and degrade these compounds.

One example of a moderately mobile pesticide studied is ethofumesate (Prograss). The distribution of ethofumesate with soil depth in turf versus bare soil was dramatically different. Ethofumesate leached to a deeper extent and persisted much longer in bare soil than in turf. Of all the pesticides studied, the effect of turf on pesticide dissipation was most pronounced for ethofumesate, where the half-life went from 56 days in bare soil to only three days in turf. The reduced half-life effectively eliminates most of the leaching risk of ethofumesate applied to turf.

MOBILE PESTICIDES

On a less positive note, pesticides classified as mobile tend to behave the same regardless of whether they are applied to turf or bare soil. We believe this is because the thatch does not retain these mobile pesticides, and so they bypass the pesticide-degrading thatch layer of turf. Both mefanoxam (Subdue Maxx) and halofenozide (Mach II) behaved about the same in turf as in bare soil. Both products quickly reached the lowest layer we sampled, six to 12 inches, by the fourth day after application.

These products may dissipate more rapidly in thatch than in soil, but they tend to move through the thatch layer quickly and are not there long enough to derive the benefit of thatch on pesticide dissipation. While small percentages of the total pesticide application rate leached to the lower soil depths, these are important amounts because once they reach these depths there is much less likelihood they will be degraded before reaching groundwater.

One very practical result of this research is the recommendation that irrigation following the application of a mobile pesticide should be as light and infrequent as practical. In other words, try to keep the pesticide in the thatch layer where it can be degraded. While

Solubility and Reported Half-Lives of Pesticides Used in the University of Illinois Dissipation Studies

Pesticide	Trade Name	Water Solubility (PPM) 20-25 C	Previously Estimated Half-Life (Days)
Propiconazole	Banner	110	110
Halofenozide	Mach II	510	?
Ethofumesate	Prograss	50	30
Cyproconazole	Sentinel	140	90
Mefanoxam	Subdue Maxx	26000	70

rainfall cannot be controlled, irrigation should be light enough that it does not move these products through the thatch for the first four to seven days after application.

However, it is important to recognize where the target zone is for a particular pesticide. Many of these products are mobile by necessity. For instance, halofenozide will not be very effective against grubs if it is tightly bound by thatch, since grubs typically inhabit the soil layer below the thatch. In fact, irrigation is often suggested as a means to move grub-control pesticides through the thatch layer.

Choose grub-control products with care. The newer products such as Merit or Mach II have more specificity (i.e., kill the pests, but cause less harm to other insects) and are less toxic than many of their predecessors. The challenge with these two products is that it is more difficult to use them curatively, and much easier to use them preventatively, which may result in overuse.

As mentioned previously, the difference in pesticide half-life between applications to turf versus bare soil was most striking for ethofumesate. Ethofumesate is a preemergence herbicide that is used as a postemergence control of annual bluegrass in turf. Clearly, it is good that ethofumesate does have postemergence activity because with a half-life of only three days, it is not going to persist long as a preemergence herbicide in turf. This result explains many of the field responses observed with ethofumesate. In our field trials, the level of preemergence control from ethofumesate was never as good as from other preemergence herbicides used in turf. We now understand why.

TURF AS A MICROBIALLY ACTIVE ORGANIC LAYER

The original goal was to develop a better and more quantitative understanding of the role of turf in pesticide dissipation and leaching. While this research certainly provides a better understanding of how turf affects pesticide dissipation rates, not as much progress has been made in quantifying the role of turf in pesticide fate. However, an initial study with cyproconazole (Sentinel) showed that the presence of turf was much more important than the amount of turf present in affecting the rate of pesticide dissipation.

Perhaps the best way to view turf is not as a wonderful filtration system that degrades everything applied to it, but rather as a highly sorptive layer of organic matter teeming with microbial activity that will reduce the potential problems caused by the introduction of pesticides into this environment. It will not eliminate these problems, but it will dampen their impact on water resources.

Exercise special care when using pesticides that are considered mobile in soil. These products are most likely mobile in turf, as well. Modify irrigation practices to retain these pesticides within the thatch layer as long as possible. When a choice exists, choose pesticides that are classified as moderately mobile or immobile over those classified as mobile.

It is the responsibility of the golf course superintendent to make wise choices regarding pesticide use and selection that minimize the risk of ground or surface water contamination. You have a good system to manage, but it still must be managed well.

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DR. BRUCE BRANHAM *is an associate professor of turfgrass science at the University of Illinois, and* DR. DAVID S. GARDNER *is an assistant professor of turfgrass science in the Crop Science and Horticulture Department of the Ohio State University.*

Half-Lives (Days) Determined in Turf or Bare Soil from Experiments Conducted in Urbana, Illinois, 1996-1999

Pesticide	Trade Name	Half-Lives (Days) Bare Soil	Half-Lives (Days) Turf
Propiconazole	Banner	29	12-15
Halofenozide	Mach II	>64	>64
Ethofumesate	Prograss	51	3
Cyproconazole	Sentinel	128	8-12
Mefanoxam	Subdue Maxx	7-8	5-6