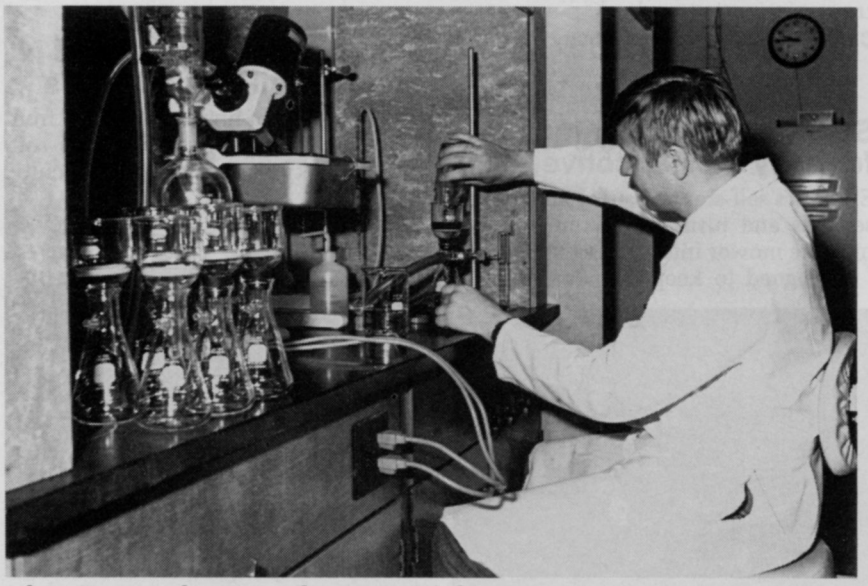
Microbes and turfgrass pesticide efficiency

by Harry D. Niemczyk, Ph.D., OARDC

Have you ever wondered what really happens to the pesticides applied to turfgrasses? How or by what means are they eventually broken down?

Nearly all pesticide degradation proceeds by the action of microbes such as fungi, bacteria and actinomycetes. Action by these organisms leads to the pesticide's ultimate elimination from the turfgrass environment. Were it not for microbial biodegradation, residues from pesticides would simply accumulate, increasing environmental hazards.

Microbial breakdown occurs most readily in situations rich with high populations of microbes. These microbes are abundant in the upper levels of turfgrass soils and super-abundant in thatch. Pesticides applied to turfgrasses reach the aerial part of the plant first, then the thatch and finally the soil. If there is no thatch, the material that misses the plant hits the soil. The capacity of microbes to degrade pesticides that reach the thatch and/or soil helps determine the amount and duration of remaining residues to control a target pest.



Adam Krause, chemist at the OARDC/Ohio State University Turfgrass Pesticide Laboratory, Wooster, Ohio, extracts residues in samples from current field studies. The vertical movement and accelerated degradation of six herbicides and nine insecticides applied to turf with and without thatch is being studied.

Degradation rate

Normally, degradation proceeds slow enough to allow control of the pest. However, an increasing amount of scientific evidence shows that the capacity of these microbes to break down pesticide residues is, in fact, a double-edged sword.

Following repeated exposure to a pesticide, the microbes can adapt to the remaining residues by using them as an energy (carbon) or nutrient source. With abundant nutrients (the pesticide), the microbe population increases rapidly, resulting in abnormally fast pesticide disappearance. This rate is much faster than when the microbes were first exposed to the chemical. It is known as "enhanced or accelerated biodegradation."

In the field, accelerated biodegradation means a significant change from previously consistent effectiveness to ineffectiveness. However, the poor performance of a pesticide must not immediately be attributed to accelerated biodegradation. Improper rate, poor distribution, incorrect timing of application and development of resistance are but a few of the other reasons for poor performance. Nevertheless, when a distinct, consistent change in effectiveness occurs—particularly against pests such as grubs or crabgrass—accelerated biodegradation of the pesticide is a strong candidate as the causal factor.

Not a new phenomenon

Accelerated biodegradation of pesticides by soil microbes is not a recent discovery. It was first reported for 2,4-D, 2,4,5-T and MCPA about 40 years ago. Since then, published laboratory and field studies have demonstrated this phenomenon with herbicides such as EPTC, vernolate, butylate, metolachlor and diphenamid. The same phenomenon has been shown for soil-applied carbamate insecticides, such as aldicarb, carbofuran and carbaryl, and the organophosphates diazinon, isofenphos, fensulfothion and ethoprop.

Enhanced degradation of the fungicide iprodine, currently used to control certain turfgrass diseases, was reported in 1986. In all these cases, accelerated biodegradation followed repeated application of the pesticide to the same site.

Studies conducted in 1986 and 1987 by the Ohio Agricultural Research and Development Center confirmed that after four successive years of applying Oftanol (isofenphos) to control grubs on the fairways of one golf course, residues from a fifth application dropped from 9 ppm (parts per million) on the day of application to non-detectible levels seven days after application. Laboratory tests confirmed that accelerated degradation was occurring.

Tests on thatch and soil from three other golf courses where Oftanol had been used successfully for at least two consecutive years, but gave poor results when applied a third time, tested positive for accelerated degradation of isofenphos.

Studies at Ohio State are continuing, but preliminary results indicate that microbes in the Oftanol-treated turf apparently have the capacity for accelerated degradation of some other insecticides used for grub control.

Research needed

The role of accelerated biodegradation as an important cause for the failure of previously effective soil pesticides used in agriculture is generally established in scientific literature. But research has only just begun on accelerated degradation of insecticides used on turfgrasses. To my knowledge, no investigations dealing with the herbicides or fungicides used in turfgrass management are in progress.

Considering the range of pesticides used on turfgrasses (especially golf course greens), I believe accelerated biodegradation has a strong potential for explaining at least some of the reduced efficacy of turfgrass pesticides experienced in the past. **LM**