Environmental Influence on Pesticide Performance

By Dr. Frank S. Rossi
Department of Horticulture
University of Wisconsin-Madison

Perspective

Efficient turfgrass management integrates cultural practices, management inputs (fertilizer, water, pesticides), and environmental awareness. Improper management decisions or adverse environmental conditions can compromise turfgrass health and reduce aesthetic quality. From a practical standpoint, weak plants are more likely to be infected, injured and less competitive to pest infestations. Turfgrass pest management requires much more than deciding on the best chemical to manage the pest. It requires a full appreciation of your quality expectations prior to determining management options. Could you get by with the current injury level or must you avoid losing any grass? Enormous advances in environmentally responsible pest management over the past decade have been a result of improved technology, including the advent of more selective, less persistent pesticides. However, the first step in pest management remains prevention through proper maintenance of turfgrass health. If managers are to use pesticides to their full advantage and without compromising environmental quality, they must understand the factors that affect their performance.

Application Specifics

A pesticide begins to interact with the environment at the moment of its application. It moves, is transported, acts, and is ultimately degraded in the environment. Interaction occurs in the atmosphere, the soil and the soil-atmosphere interface with plants and soil microorganisms. Perhaps the most critical phase involves those interactions from the moment the pesticide arrives at the plant or soil surface until it reaches its site of action. Sprayer calibration is an extremely important step in any pesticide application. Yet, it is the step most often estimated, forgotten, or totally ignored. A study conducted at the University of Nebraska reported that of the 53 public and private golf courses surveyed, 83% misapplied pesticides. This was shown to cost approximately $25.00 per acre of turf and does not include cost of injury to the turf from over-application or non-efficacy. As a pesticide is discharged from a nozzle there is potential for drift. Drift is influenced by spray pressure, surface tension of the spray droplet, nozzle orifice diameter, amount of wind, and boom height.

Pesticide Fate

Chemicals can change physical state from a liquid or solid to a gas, via a process called volatilization. Volatilization can occur after release of the pesticide from the sprayer, as it travels through the air, or after it has hit the plant or soil surface. Volatilization increases as air temperature increases, thereby increasing plant or soil surface temperature. Vapor drift occurs when wind moves vapors off the intended target area and causes injury to adjacent plant material. This is of particular concern with broadleaf herbicides formulated as esters, such as 2,4-D. If we consider preemergence herbicides or fungicides used for root pathogens to be soil-applied products, there are several processes that may occur upon contacting the soil. The chemical can be degraded by light (photo decomposition), microorganisms, or by chemical degradation. Each of these ultimately will alter the efficacy of the pesticide. Additionally, the pesticide might be adsorbed. Adsorption is the binding of pesticides on soil particle surfaces, specifically to clay particles and organic matter, especially thatch. These surfaces, through their cation exchange ability or physical attraction, can concentrate pesticides and remove them from the soluble state. The pesticide has to be in soluble state to be taken up by plants. Adsorption is one of the most important mechanisms for the reduction of the concentration of pesticides in the soil and can play an important role in leaching. Leaching of pesticides is movement of chemicals due to the action of water. It is usually considered movement down in the soil profile into or through a zone of action. The leachability of a pesticide is directly related to its

(Continued on page 17)

(Continued from page 15)
water solubility, the amount of water moving in the soil profile, and its adsorption.

Environmental Effects on the Plant

Foliarly-applied postemergence herbicides or contact fungicides are subject to similar environmental conditions which can influence performance such as volatilization, adsorption to the cuticular surface, and photo-decomposition. Still, the nature of the target, i.e. the plant, creates several different challenges from the environment. Plant morphology, or shape, orientation, and nature of leaf surfaces are influential. A large broadleaf parallel to the soil surface is much more effective at capturing spray particles than an upright narrow leaf blade. This fact is complicated further under moisture-stress conditions where many leaf blades roll inward to conserve moisture. Additionally, hairy leaf surfaces could prevent intimate contact of pesticide droplets and leaf surfaces and allow for volatilization or possibly reduced absorption.

Moisture Stress and Herbicide Performance

Finally, some of my research at Cornell University demonstrated the impact of moisture stress on the performance of fenoxaprop (Acclaim) for postemergence crabgrass control. We found that there is a combination of factors which are influenced by moisture stress which leads to reduced efficacy, with the paramount influence being the affect of moisture stress on growth. Subsequently, we investigated irrigation scheduling to determine an optimum timing to alleviate the moisture stress and possibly enhance fenoxaprop performance. The results of the irrigation study indicated that excellent crabgrass control was achieved when we irrigated the moisture-stressed plants the day of the herbicide application and up to 48 hrs. after application. Additionally, another study indicated that when irrigation is not available, the tank mix combination of fenoxaprop and pendimethalin was able to control moisture-stressed crabgrass. This tank mix was found to be synergistic and able to provide consistent postemergence crabgrass control under variable environmental conditions. I will discuss this research more completely in future articles.

Summary

Before you make a pesticide application think about plant health, your pest management options, pesticide application parameters, the fate of pesticides and the influence the environment has on each of these issues. A healthy appreciation of the interactivity of these processes will result in more effective and efficient pest management decisions without compromising environmental quality.