ENVIRONMENTAL INFLUENCE ON HERBICIDE PERFORMANCE

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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, which leads to a decrease in aesthetic quality. From a practical standpoint, if bare areas exist in the turfgrass sward they are usually colonized by weeds, which substantially reduce quality. Managing weeds in turfgrass requires much more than which is the best chemical to control the problem weed. It requires a full appreciation of quality expectations prior to determining management options which will increase maintenance requirements.

Enormous advances in weed control over the past decade have been primarily due to the advent of herbicides for the selective control of weeds. The increase in available herbicides for use in turf has substantially impacted a manager's ability to provide a high quality product. This is primarily due to the perennial nature of turf and lack of available options once a weed infestation occurs. Consequently, the best method of weed control in turf is prevention through proper maintenance of turfgrass health. Still, if managers are to employ herbicides to their full advantage and minimize potential dangers to environmental quality, they must understand the factors that affect their performance.

A herbicide 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, in the soil, at the soil-atmosphere interface, and with plants and soil microorganisms. Perhaps the most critical phase that determines its ultimate effectiveness and selectivity involves those interactions from the moment the herbicide arrives at the plant surface until it reaches its site of phytotoxic activity.

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.

The first thing that can happen to a liquid herbicide when it comes out of the nozzle is drift. Drift is influenced by the pressure of release, the surface tension of the droplet, nozzle orifice diameter and how much it breaks up the particles, the amount of wind, and the height above the ground where the spray is released.

Next, the chemical can change its physical state from a liquid or solid to a gas, which is referred to as volatility. Volatilization can occur after release of the herbicide from the sprayer as it travel through the air or after it has hit the plant or soil surface. Volatilization increases as air temperature increases subsequently increasing plant or soil surface temperature. A combination of volatilization and drift occurs when wind moves volatile vapors off the intended target area and causes injury to adjacent plant material.

If we consider preemergence herbicides 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 herbicide. Additionally, the herbicide might be adsorbed. Adsorption is the process of accumulation at an interface, and in this case the interfaces of concern are the clay and organic matter colloidal surfaces. These surfaces through their cation exchange ability or physical attraction can concentrate herbicides and remove them from the soluble state which is usually considered to be the state which plants take them up. Adsorption is one of the most important mechanisms for the reduction of the concentration of herbicide in the soil and can play an important role in leaching.

Leaching of herbicides is defined as the movement of herbicides 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 herbicide is directly related to its water solubility, the amount of water moving in the soil profile, and its adsorption.

Foliarly-applied postemergence herbicides are subject to similar environmental conditions which can influence performance such as volatilization, adsorption to the cuticular surface, and photodecomposition. 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. A large broad leaf 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 herbicide droplets and leaf surfaces and allow for volatilization or possibly reduced absorption.

Finally, some of my research at Cornell University demonstrated the impact of moisture stress on the performance of fenoxaprop (Acclaim) for postemergence crabgrass control and how to enhance effectiveness with irrigation or tank mixing. We found that there are a combination of factors which are influenced by moisture stress which leads to reduced efficacy, with the paramount influence being the affect 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 statistically synergistic and will provide consistent postemergence crabgrass control under variable environmental conditions.