Welcome to:
Pesticide Education Resources @ University of Nebraska-Lincoln

Category Core: Ornamental and Turf

CHAPTER NINE

Environmental Concerns

Learning Objectives

After completing this chapter, you should be able to:

- Comprehend the environmental benefits of healthy turf;
- Identify the first steps in avoiding misapplication of fertilizer;
- Develop an awareness of the environmental hazards associated with misuse of pesticides;
- Explain the difference between "transportation" and "transformation;" and
- Understand how following appropriate application principles can reduce environmental hazards.

Terms to Know

Transformation. When a pesticide's chemical structure is altered

Transportation. The movement of a pesticide away from its intended site of action.

Volatilization. Occurs when a pesticide changes from a solid or liquid phase to a gaseous phase.

Particle drift. Occurs when small pesticide spray particles move away from target areas.

Photodecomposition. Sunlight-induced transformation of a pesticide.

Buffer zone. A strip of land that is left untreated by fertilizers or pesticides in order to protect chemical-sensitive areas next to the application target area.

Introduction

Concerns are increasing about water contamination from fertilizer and pesticides used on urban grass. Actually, thick, healthy lawns limit pesticide runoff. Dense turf reduces the velocity of runoff by allowing greater infiltration into both the thatch and rootzone where microbes can begin breaking down the chemicals. When good cultural practices are followed and chemicals (fertilizers and pesticides) are used responsibly, the environmental benefits of turfgrass outweigh the potential for water contamination.

The Benefits of Turfgrass

A well-maintained lawn, park, or golf course creates an inviting view, and turf supplies the perfect backdrop for other landscape elements. But a growing body of evidence points to the positive health and environmental contributions made by turfed areas that go beyond aesthetics. A healthy and vigorous lawn provides the following benefits:

- Produces (with every 25 square feet) enough oxygen for one person for one day;
- Absorbs gaseous pollutants (such as carbon dioxide) from vehicles thus serving to combat the greenhouse effect implicated in global warming;
- Controls dust and pollen in the air that can cause allergic reactions;
- Provides significant cooling;
- Reduces noise by absorbing, deflecting, reflecting, and refracting sounds; and
- Reduces discomforting glare and light reflection.

Turfgrasses can play a significant role in reducing runoff. Water volumes running off natural groundcover area may be as little as 10 percent of rainfall, compared to 55 percent from areas that are mostly paved. In fact, a thick and carefully managed turfgrass reduces runoff volume to almost zero, which is 15 times less runoff than a lower quality lawn. An average golf course of 150 acres can absorb 12 million gallons of water during a 3-inch rainfall.

Furthermore, the turfgrass rootzone is a unique soil system. A healthy turf rootzone will help improve soil processes that facilitate the breakdown of various organic pollutants, air contaminants, and pesticides used in lawn care.

Use Fertilizers Responsibly

Few soils have enough natural fertility to maintain desired turfgrass quality and recuperative ability throughout the growing season. However, improper management and use of turf fertilizers can contribute to pollution of both surface waters and groundwater. Being careful to avoid over-application or misapplication of these materials and basing turf nutrient requirements on a reliable soil test are the first steps in responsibly using fertilizers to protect water resources. Combining appropriate landscape management practices with a modest turf fertilization program may further reduce potential water pollution.

Use Pesticides Responsibly

Chemical pesticides can help provide sustained turfgrass quality, and often reduce both labor and energy costs. Despite these cultural and economic benefits, controversy over the environmental effects of pesticide use has emerged. Pesticide residues resulting from overuse or improper use have been associated with adverse environmental effects, including:

- Reduction of certain bird populations;
- Appearance of detectable residues in aquatic ecosystems;
- Implication of many pesticides as potential carcinogens;
- Long-term soil contamination with persistent pesticides;
- Destruction of nontarget organisms; and
- Evolution of resistant pest strains.

Environmental Influence

The fate of pesticides in the environment can generally be grouped into two classes:

- Transportation processes result in the movement of a pesticide away from its intended site of action. Leaching and runoff potential are of interest because they may affect water quality.
- Transformation results when a pesticide's chemical structure is alteredusually a desirable fate, because most pesticides used today thus become less toxic or nontoxic. The table below lists the more important transportation and transformation factors affecting the fate of pesticides in the environment.

Factors Affecting Pesticide Fate

Transportation processes	**Transformation processes**
Leaching	Photodecomposition
Runoff	Microbial decomosition
Volatilization	Chemical degradation
Partical drift	
Adsorption	
Plant absorption	

Transportation Processes

Leaching

Leaching is the downward movement of pesticides and nutrients through the soil. It is the process responsible for carrying pesticide and nutrient contaminants to groundwater resources. In turfgrass, any analysis of a pesticide's potential to leach to groundwater must take into consideration the amount of product that moves down to the soil surface and ultimately past the turfgrass root system. Turfgrass density, depth and quantity of rooting, and thatch development can significantly effect leaching potential.

Recent studies from several universities have demonstrated that grass and thatch present a barrier to movement of several common turfgrass insecticides and herbicides. Though the scientific data regarding the potential leaching of pesticides into groundwater below turfgrass areas is limited, what is available is encouraging; there appears to be minimal downward movement.

Runoff

Runoff occurs when the precipitation rate exceeds the rate of water infiltration into the soil. There can be significant loss of pesticides and nutrients from row crop sites where pesticides are applied to bare soil and not held in place by plants. When runoff occurs from these areas, a pesticide can dissolve and be carried off-site in runoff water; or, if bound tightly to soil particles, it can be carried as sediment in runoff water.

Recent studies have shown that a well-maintained, dense turf area can reduce runoff to nearly zero. It appears that turfgrass stands significantly limit runoff, thereby reducing the chances for off-site movement of pesticides.

Volatilization

Volatilization of a pesticide occurs when it changes from a solid or liquid phase to a gaseous phase. This change in physical state occurs at a specific pressure (known as vapor pressure) for that pesticide. Vapor pressure is the point where solids vaporize and liquids evaporate.

Volatilization is generally a concern when using broadleaf herbicides formulated as esters. Ester formulations have a much greater tendency to volatilize than do amine forms. Sometimes additions are made to the ester molecule to make a lower volatile ester that can be used more safely.

However, ester formulations should never be used when temperatures are above 80 to 85 degrees F. and the relative humidity is low.

Particle drift

Spray particle drift away from the intended target is an important and costly problem in residential settings. Drift lowers the amount applied to the target area which reduces effectiveness, and can damage off-target sites, resulting in environmental contamination.

Particle drift is the actual movement of small spray particles away from the target area. Several factors affect particle drift, but the most important is the size of the spray droplet. Small droplets fall through the air slowly and are carried further by air movement. Whenever possible during application of a liquid pesticide, keep the pressure of the pesticide solution as low as practical. Droplet size is thereby kept larger and less susceptible to drift.

Be aware of excessive winds that can cause a pesticide to move from the target area to nontarget sites. Most recommendations are to stop spraying if wind speeds are over ten miles per hour or when adjacent to sensitive plants. Also be aware that the presence of houses and buildings can modify wind direction and intensity. Because of this building influence on wind, particle drift potential is increased.

Absorption

Absorption is the movement of pesticides into a plant and, to a much lesser degree, soil microorganisms. Once absorbed, most pesticides are broken down by the plant. When the plant or plant part dies, any remaining residues can serve as a food (energy) source for soil microorganisms.

Transformation processes

Photodecomposition

Sunlight-induced transformation can be an important fate for some pesticides. These changes generally alter the chemical properties of a pesticide, making it less toxic (sometimes less effective) and more susceptible to further breakdown by chemical or microbial processes.

The dinitroaniline herbicides (e.g., benefin, trifluralin, pendimethalin, and prodiamine) are susceptible to photodecomposition. However, once they are watered into the soil they are unaffected by further

photodecomposition

Microbial Decomposition

The most common means of pesticide degradation is the action of microorganisms found in soil and thatch. Microorganisms use the pesticide as a food source, resulting in pesticide degradation. Microorganisms also may alter the structure of the pesticide, usually resulting in detoxification and ultimately in further degradation.

Environmental conditions significantly affect the activity of soil microbiological population. Warm, moist soil that is well aerated and has a pH range of 6.5 to 7.0 encourages high microbial activity. Enhancing biological activity in the soil encourages faster breakdown and degradation of applied pesticides.

Chemical Degradation

The hydrolysis of pesticides (i.e., the way a pesticide reacts with water) also can be an important fate process. Hydrolysis of pesticides may be enhanced or reduced by the presence of mineral or organic absorbing surfaces. Further research will perhaps clarify some of these processes.

Pesticide Application Practices

The first step in responsible pesticide application is to determine if pesticides are really necessary. Before applying insecticides and fungicides to a turf area, be sure that the apparent damage symptoms are being caused by a pest. If an insect or disease pest is found to cause serious turf damage, then a proper control method can be selected. This may or may not involve the use of a pesticide. Also, weeds should be identified to determine whether there is a need for herbicide, because weeds may only be indicative of inappropriate cultural conditions.

Determine the Economic Threshold

Make every effort to determine the economic pest damage threshold level before applying pesticides. A healthy turf can withstand a certain amount of pest damage without causing permanent damage. Some grass plants may be lost to the pest, but the remaining grass plants quickly fill in areas thinned or left open by pest attack.

Read the Label

The most important pesticide application practice for protecting the environment is to follow pesticide label directions exactly as they are stated on the product container. The label provides all the information you need to apply a pesticide so that all nontarget plants and organisms in the environment are protected (including you).

Timing

Proper timing of pesticide application is crucial to minimize adverse environmental impacts while still effectively eliminating the pest. When the pest is in a young and/or highly vulnerable stage, minimal amounts of pesticide can be effective. Greater amounts of pesticide are needed when weeds or insects are large and mature, and the increased amount still might not be effective in controlling the problem.

Postapplication Irrigation

Preemergent herbicides, typically used for controlling crabgrass and other annual weedy plants, must be moved into the soil surface to be effective. They affect the seed as it begins to germinate, before the plant emerges from the ground. Depending on the soil type, 1/4 to 1/2 inch of moisture should be applied following application of these productsabout 1 to 2 hours of irrigation with most common lawn sprinklers.

Application Water Volume

It is not necessary to thoroughly drench an area with an herbicide to achieve satisfactory weed control. This may be wasteful of both water and herbicide and may move the herbicide beyond the plants and into the soil where it is prone to leaching, or where plant cover is sparse and the herbicide could potentially run off. Spraying to wet the foliage is sufficient to get enough herbicide into the plant to be effective. Again, follow label directions for both proper mixing and for proper postapplication watering.

Application Practices for Fertilizers or Pesticides

- Never directly deposit or inadvertently apply fertilizer or pesticides into lakes.
- Fill granular spreaders on a hard surface where spills can be cleaned up easily. NEVER wash spills into the street or other hard-surface areas where they can enter storm sewers and ultimately surface water.
- Close the gate on the granular spreader when crossing hard surface areas, or go back and sweep up the material for reuse.
- Drop spreaders are more precise, but slower than rotary spreaders. However, near shoreline areas, make applications close to the lake with a drop spreader to avoid accidental contamination of the water. Applications to areas farther away from the shoreline can be done with a rotary spreader. The same precautions should be taken when using liquid applications.
- Avoid getting fertilizer or pesticides into natural drainage areas or pathways on a property. These may not necessarily be hard surfaced areas. Fertilizer and pesticides can be carried directly into surface water before it has a chance to infiltrate into the surrounding turf/soil area.
- For shoreline areas, a buffer zone of unmanaged grasses or possibly natural vegetation could be left around the shoreline. This natural area helps prevent erosion from adjacent shoreland, and may retain some nutrients that would otherwise go into the lake.
- Except for special situations (such as golf greens), grass clippings should be returned to the turf area to decompose, thereby recycling nutrients back to the turf. Since grass clippings are a source of nutrients, particularly nitrogen, they should not be blown into street gutters, or on sidewalks or driveways where they can be carried by runoff to surface waters, or be blown directly into surface water areas. If they get into the surface water, these nutrients will be released to the water environment upon decomposition, creating nutrient enrichmenta prime cause of undesirable algae and vegetative growth.

Summary

Protecting surface water and groundwater is not something to be taken lightly. But neglecting turf areas for fear of introducing nutrients and pesticides into water supplies is not a way to protect these resources. Properly maintaining turfed areas with appropriate but modest use of fertilizers and pesticides will do more to protect water resources than to hurt them.

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