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Turfgrass Species for Pennsylvania

Department of Crop and Soil Sciences - Cooperative Extension

Developing an Integrated Turfgrass Pest Management Program

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Introduction

Turfgrasses, like all other plants, are subject to the ravages of pests. A turfgrass pest can be defined as any organism causing a measurable deterioration in the aesthetic or functional value of a turf.

Most turfgrass pests are weeds, diseases, or insects, but they can also include rodents, birds, and pets. Nearly every lawn, golf course, athletic field, or institutional ground harbors some pests. It is only when these pests build up to sufficient levels to cause intolerable damage that they need to be controlled.

Establishing a pest management program requires planning, vigilance, and, above all, knowledge of turfgrass culture. It also requires a complete understanding of the pests, including recognition of the pest and the damage it causes, its life cycle, environmental or cultural conditions that favor its development, and methods of control.

What is Integrated Pest Management?

Integrated pest management (IPM) is a pest management system that is gaining popularity and acceptance in the turfgrass industry. It incorporates all suitable control techniques to keep pest damage below an established threshold level. The use of IPM strategies should result in effective pest control with minimal impact on the environment and on people. It is important to understand that IPM is not pesticide-free turfgrass management. However, a successful IPM program should result in a more efficient use of pesticides, which usually means a reduction in pesticide use.

IPM requires training in all phases of turfgrass management, including biology, soil science, pest management, and cultural practices. It usually involves establishing pest response threshold levels that are consistent with the intended use of the turf, intensive field monitoring, good record keeping, and consideration of different pest control strategies. Together, these components form the basis for the decision-making process that will determine the success of the IPM program.

The goal of a turfgrass IPM program is to keep pest populations or damage at a tolerable level. This is called the pest response threshold level. It is determined by the number of pests or the amount of pest damage that can be sustained before an unacceptable reduction in turf quality occurs. Pest response threshold levels vary from site to site and are based on the use of the turf and the user's needs or expectations.

In the case of a home lawn or institutional grounds, the primary reasons for using turf is soil stabilization and aesthetic value. The level of pest damage that can be tolerated on home lawns and institutional grounds may vary, depending on the value placed by the user on aesthetics.

On a golf course, aesthetic value is important but playability is the primary concern. For instance, if the surface of a putting green is disrupted by disease injury or weeds, this may interfere with the roll of the ball, thus affecting the outcome of the match. Therefore, the pest response threshold level for golf putting greens is extremely low. The threshold levels for golf course fairways and roughs, however, are usually much higher than for greens since a smooth, blemish-free surface is not as important for play on these portions of the course.

Safety and playability are the most important features of an athletic field. It is generally accepted that diseases and insects that damage turfgrass roots and crowns can result in reduced cushioning and poor footing, contributing to a greater chance of injury to athletes. Weeds should also be kept to a minimum because they create poor footing. Pests that cause superficial damage to foliage, such as red thread disease, can probably be assigned a relatively high threshold level since safety and playability would not be seriously compromised.

The keystone of a turfgrass IPM program is frequent, careful monitoring of pest activity. If the monitoring program is successful, pests can be detected early and controlled before the threshold level is exceeded. By keeping good records of previous pest activity, turfgrass managers will know where and when to look for subsequent pest infestations.

The various pest control options used in a turfgrass IPM program include cultural, biological, genetic, and chemical controls. Cultural practices are methods of pest control if they result in a healthy and more pest-resistant turf. Cultural practices could include the use of certified seed or sod to reduce the introduction of weeds into a newly established turf. They could also involve mowing the desired turf species at the proper height, correcting nutrient deficiencies, and practicing good irrigation techniques.

Biological pest control methods (sometimes called biorationals) include using parasites or other biological agents to inhibit turfgrass pests. Biological agents that may be classified as biorationals include bacteria, fungi, or nematodes. Examples of biorationals used on turfgrass pests are Bacillus popilliae, a bacterium that causes milky disease of Japanese beetle grubs; turfgrass cultivars containing endophytic fungi that deter leaf- and stem-feeding insects; and beneficial parasitic nematodes for insect control.

Genetic control options involve using pest-resistant turf species and varieties. Although no turf species or variety is immune to all diseases and insects, some are better able to withstand damage from certain pests than others.

Chemical control of turfgrass pests with conventional synthetic pesticides is also an important part of an IPM program. It is essential to choose the proper pesticide for the target pest, to apply pesticides only when necessary, and to alternate pesticides so that pests are less likely to develop resistance to the chemical.

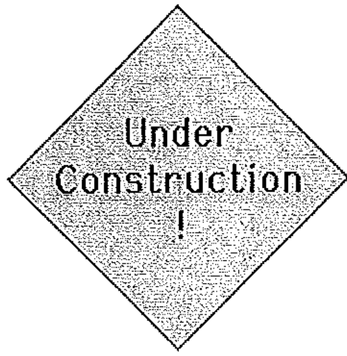

Figure 1

Steps in Developing a Turfgrass IPM Program

Five important steps are involved in developing a turfgrass IPM program. The first is assessing site conditions and characteristics, followed by making a survey of pests, determining pest response threshold levels, developing a monitoring and record-keeping program, and finally, making the decisions that lead to the selection of control options.

1. Assessing Site Conditions and Characteristics. The objective of the site assessment is to collect all site-related information that can affect the health of turfgrasses and the degree to which they can withstand pest infestation. During the site assessment, the turfgrass manager should examine the amount of shade present, the density of ornamental plantings or other barriers surrounding the turf that may restrict air movement, soil fertility, soil compaction, drainage, the current cultural program, and in some cases, how the turf is being used. Any site condition that can limit turf vigor or favor a potential pest should be noted so that steps can be taken to correct the situation.

Excessive shade results in deterioration of Kentucky bluegrass and often promotes powdery mildew disease. Selecting grasses that are better adapted to shaded conditions and pruning branches from surrounding trees may alleviate this problem.

Dense plantings of ornamental shrubs and trees around golf greens restrict air movement and may increase the likelihood of disease. Removing some of the trees and shrubs will improve air flow and encourage drying, thus reducing the potential for disease.

Plant nutrient deficiencies or excesses, or extremes in pH, can weaken the turf and result in increased disease injury or weed encroachment. A soil test should be taken during the site assessment so that fertility levels and pH can be determined and adjusted if necessary. Soil test kits and sampling instructions can be obtained from Penn State Cooperative Extension offices for a nominal fee. Soil testing services are also available from other universities and from private companies.

Any turf-limiting soil conditions, such as compaction or poor drainage, should be noted during the site assessment. It may be necessary to implement a vigorous aeration program to alleviate compaction problems. Also, drainage tile can be installed to increase drainage in areas that remain wet for long periods.

The cultural program should be designed to favor the most desirable turf species at the site. Factors such as mowing practices, fertility management, irrigation practices, thatch management, and aeration should all be considered.

If turf use is not managed properly, significant damage can occur and additional pesticide applications may be necessary. On an athletic field, for instance, the intensity of use can be so great that the turf suffers from excessive wear and soil compaction. The result is a reduction in turf cover and an increase in weed populations. This situation can be corrected by distributing traffic to other locations and by closing the facility when the turf is under heat and drought stress, or if the field is excessively wet.

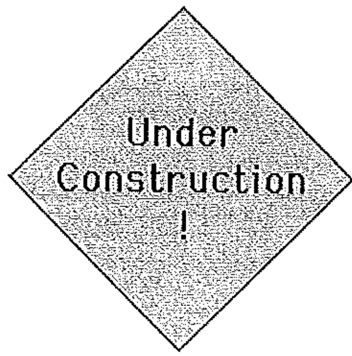

Figure 2

2. Surveying Pests at the Site. The pest survey involves determining the identity, location, and populations of turfgrass weeds, insects, and diseases at the site. It also involves identifying the environmental conditions and times of the year that certain pests are likely to occur or cause damage. The pest survey should be carried out over a period of several months or years, since certain pests occur only at specific times of the year and others may only occur once every two or three years.

Identifying turfgrass pests may be a difficult task for the beginner, but there are many good reference books that provide photographs and drawings of pests. As you become more familiar with diseases, insects, and weeds, identification becomes easier. Once the identity of the pest(s) is determined, the location should be recorded for future reference. Maps are an ideal way of documenting the location of pests, because the area can be outlined and color coded to indicate specific pests.

Assessing pest populations can be difficult and time-consuming. Not many turfgrass managers have the time or the resources to make detailed counts of specific pests. One way to keep track of weed and disease populations is to record a rough estimate of the infested area rather than count the number of weeds or patches of disease. Although this is not a very accurate method, it can provide an indication of the pest population and may be useful in evaluating the effectiveness of control procedures.

Keeping track of weather conditions and the time of year that certain pests occur can serve as a guide for future monitoring programs. If, for example, damage to a golf course fairway resulted from brown patch disease in late June, then monitoring for this disease should begin in early or mid-June the following year.

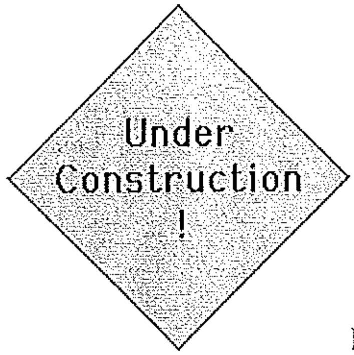

Figure 3

3. Determining Pest Response Threshold Levels. Once the site and pest assessments have been completed, the pest response threshold levels should be established for each pest. Threshold levels for commodity crops such as corn or alfalfa are based on economics. Using this approach, pest management actions are withheld until the economic losses caused by pests approach the cost of the pest management action. Since turfgrass is not a commodity crop (with the exception of sod), the threshold levels are based on aesthetics and on the use of the turf. Because users differ on what constitutes an acceptable level of damage, it is difficult to assign standard guidelines on pest response threshold levels. Determining a threshold level involves discussion and agreement between the turf manager and the user.

Threshold levels can be very general or quite specific. A golf course superintendent may decide to spray a fairway when he visually estimates that clover infestation is greater than 5 percent. Considering the large size of a typical golf course fairway, such an estimate provides a very rough approximation of the actual amount of clover. This is an example of a very general or nonspecific threshold level.

An athletic field manager may decide to treat with an insecticide when there are 10 or more grubs per square foot of turf. This is a very specific population count that involves digging up square-foot sections of turf and finding all the grubs contained within. The procedure must be repeated so that a representative sample of the entire field is obtained. Very few specific threshold levels have been determined that would apply to a wide range of turf management situations.

Factors to consider in attempting to establish threshold levels are the use of the site, the aesthetic value of the turf, and the potential of a pest to cause serious turf injury. Since use will vary for each site, pest response thresholds will differ accordingly. For example, a limited amount of grub damage may be tolerated by some homeowners since the damaged area can be repaired in the fall. On athletic fields, however, grub damage cannot be tolerated, because fall turf repair is usually impossible due to heavy field use. Grub damage can also cause weak rooting, which can result in poor footing and a greater chance of injury.

Some homeowners are meticulous about the appearance of their lawn. They expect the turf to be free of any blemish, regardless of how superficial the damage may be. Not only is this an unrealistic goal, it is not a very practical approach to pest management. Most homeowners are more reasonable about the appearance of their lawn and are willing to tolerate a few weeds and superficial disease and insect damage. A professional turfgrass manager should try to communicate with his or her clientele as often as possible to stress the importance of establishing pest response threshold levels and achieving reasonable pest management goals.

An important consideration in establishing a pest response threshold level is the potential of the pest in question to cause serious turfgrass injury. Pythium blight, for example, is capable of causing extensive turf damage in a very short time. Golf course superintendents typically spray a fungicide for Pythium blight when conditions are conducive for disease development or at the first sign of disease activity. By contrast, a significant infestation of rust disease can be tolerated by most turfgrass managers since rust is slow to develop and does not kill the affected plants.

Pest response threshold levels can vary from one location to another. For example, a moderate amount of crabgrass can be tolerated in areas of low visibility on institutional grounds. However, the turf must be relatively free of weeds in high visibility areas or in locations that accent buildings or ornamental plantings.

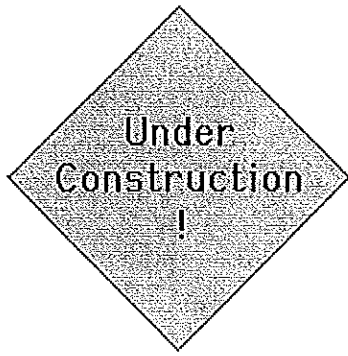

Figure 4

4. Developing a Monitoring and Record-Keeping Program. The monitoring techniques used in a turf IPM program vary depending on the type of pest and the resources available to the turf manager. Frequent visual inspection of the site is the most common means of monitoring. Golf course superintendents, for instance, visually inspect putting greens and fairways daily for signs of disease activity. Early signs of disease activity can be detected by noting the presence of fungal mycelium early in the morning.

Monitoring weather conditions is one of the best means of anticipating pest development and damage. Studies in Pennsylvania have shown that Pythium blight is likely to occur when maximum daily temperatures are above 86° F, the relative humidity is greater than 90 percent for at least 14 hours, and the minimum daily temperature does not fall below 68° F. If these conditions are forecast, a preventative spray application may be justified. Technological advances in weather monitoring equipment now allow integration of weather information with computer models designed to predict outbreaks of certain diseases.

Various types of traps can be used to monitor populations of some insect pests. Pitfall traps allow monitoring of adult bluegrass billbug populations. Sex attractants or pheromone traps are sold commercially as a means of monitoring Japanese beetle adults. Keep in mind that some attractants can draw insects from other areas, and the accuracy in predicting pest populations from traps baited with these compounds will depend partly on the location and number of traps.

The cause of turf damage is often difficult to determine. Injury may be blamed on diseases or insects when the actual cause may be unrelated to pest activities. When in doubt, a good starting place for diagnosing turf pests or pest injury is a reference manual. A good manual will show photos of the pest and the injury it can cause. Manuals can indicate important information about the life cycles and conditions that could enhance the problem.

In some cases, even a reference manual will not be sufficient, and additional assistance may be required. Disease samples or insect specimens can be submitted to diagnostic clinics at universities or private companies. It is important to first obtain instructions for collecting and submitting pest samples to ensure a quick and accurate diagnosis.

Accurate records of pest problems at a particular site can be a valuable aid in a successful IPM program. Record keeping can aid in determining the best location and timing for a pesticide application. A good record-keeping system can reduce the chance of repeating errors.

A good record-keeping system should include the name of the pest, where the pest occurred, and the amount of damage it caused. Other important information could include the approximate date at which the pest or pest damage occurred, the weather conditions present, the control measures used, and the results. Details on pesticide applications should involve the name of the product or products used, rates, formulations, the type of equipment used for the application, the name of the person who applied the treatment, and the results obtained from that treatment. Pennsylvania law requires that commercial pesticide applicators keep records of all pesticide applications for a minimum of three years. A sample pesticide application record form is provided below.

5. The Decision-Making Process. The decision to implement pest control measures in a turfgrass IPM program involves using and interpreting information from the site assessment, the pest survey, pest response threshold levels, and the monitoring program. Site assessment information can be used to develop management strategies designed to improve turf vigor and reduce the level of infestation. Pest survey information can be used to determine which pests are present at the site. Once pest response threshold levels have been determined, a program can be initiated to monitor populations and pest development.

When and if a pest becomes a problem, it should be identified so that the proper control measures can be selected. This may involve assistance from reference manuals or from other sources. Once the pest response threshold level has been reached, the decision to use control measures can be made. Control options can include cultural practices, genetic controls, biorationals, and/or pesticide applications.

The decision to implement particular control options depends on several factors. These include the effectiveness of the control procedure, cost of the treatment, size of the area to be treated, availability of labor, availability of equipment necessary to do the job, and reaction of the end user. It is also important to consider any possible side effects that may result from your course of action, such as damage to the turf (phytotoxicity), nontarget effects (bird kills, leaching or runoff of pesticides, or enhancement of other pests), or the possibility that a pest will become resistant to a pesticide.

You should consider the pros and cons of each option and make the decision based on all available resources as well as your knowledge and experience. Once the decision is made and a course of action implemented, the program should be evaluated for its effectiveness. Obviously, if the program does not achieve the desired results, some changes will have to be made.

In conclusion, turf IPM is a responsible approach to pest management. It calls for individuals with good training in nearly every phase of turf management. The practice of IPM should lead to a higher degree of professionalism, which usually means better public and customer relations and fewer mistakes. Turf IPM may be more labor intensive and initially more expensive than conventional pest management programs, but it will usually prove to be the best management system for the manager, the user, and the environment.

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among the first to complete metamorphosis, typically emigrating from ponds by early July (5). In contrast, tadpoles of American bullfrogs were found only in permanent ponds, and green frogs were more likely to be found in long- or permanent-hydroperiod ponds (Figure 2). Both of these species have tadpoles that take much longer to complete metamorphosis (two years for bullfrogs and one year for green frogs) and therefore require ponds with longer hydroperiods for successful reproduction.

The take-home message from this research is that maintaining the entire amphibian community on your golf course requires ponds with a variety of hydroperiods on or adjacent to the course. It is critical to have ponds that dry annually because some species only use seasonally flooded ponds (9). In addition, ponds should not be stocked with fish. Fish are major predators of amphibian eggs and larvae, which is why many species of amphibians tend to avoid ponds with fish. Finally, we have found that the vegetation in ponds can be important to certain species. For example, wood frogs tend to have larger populations in ponds with extensive coverage of buttonbush (*Cephalanthus occidentalis*) (3), whereas spring peepers (*Pseudacris crucifer*), tend to thrive in ponds with no canopy closure (Figure 3).

Effect of grass height and habitat on movements

To assess whether grass height may affect movement of amphibians, during the 1998 field season we constructed two square pens (50 feet [15.2 meters] on each side) on a 9.8-acre (4-hectare) section of creeping bentgrass, which is used by the turfgrass group at the University of Rhode Island for a variety of experiments. The perimeter of our experimental pens was encircled with 1.6-foot (0.5-meter)-tall silt fence. The pens were subdivided into four quarters (25 feet [7.6 meters] per side). Each quarter (randomly selected) was mowed to a grass height similar to those found on golf courses (0.25 inch [0.635 centimeters], 0.5 inch [1.27 centimeters], 1 inch [2.5 centimeters], and greater than 1 inch.

All experiments were conducted on rainy nights, when amphibians were likely to move. During the experiment, an individual amphibian (wood frog, American toad [*Bufo americanus*], green frog, bullfrog or pickerel frog [*Rana palustris*]) was placed in the center of the array, and its movements were monitored for a three-minute period (Figure 4).

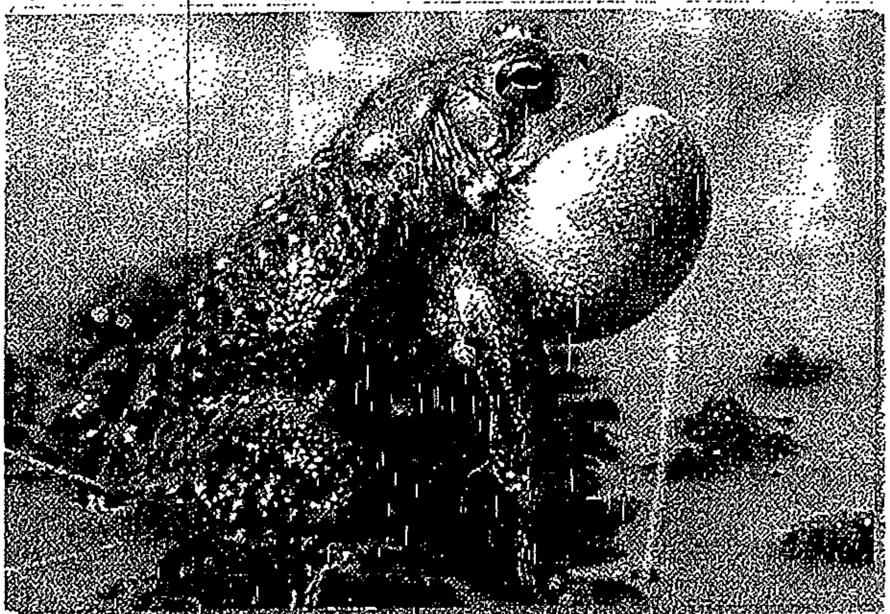

Figure 4. The American toad is widespread throughout North America, with a range that extends from east of the Rocky Mountains to the Atlantic coast and from the middle part of Canada to Mexico.

During grass-height experiments, we found no evidence that frogs preferred any grass height during the three-minute trials; that is, movements were random with respect to grass height. This suggests that grass height, at least in the height range we quantified, which is typical of current golf courses in North America, does not hinder or enhance amphibian movements.

We also constructed another set of experimental pens at ecotones between a forest and turf mowed at 0.5 inch (1.27 centimeters) or less, and a forest and dirt-covered barren areas. During these experiments, all species were more likely to seek cover in the forest and avoided the turf and open habitats.

The results are true for the species we sampled, but we did not have the opportunity to investigate movement patterns of any salamanders or some frogs, spring peepers and gray tree frogs, whose movements could be affected by grass height. However, we did find that amphibians (frogs in this case) preferred to move into forested habitats from either turf or barren areas. In both cases, the evidence shows that wooded habitats were preferred over barren ground or turf. This suggests that, for movement corridors, amphibians preferred forested habitat to open habitats such as fairways.

Turf and amphibian dispersal from a series of ponds

We also conducted an observational study to assess the influence of habitat on movement behavior of amphibians. From 1998 to 2000, we monitored the immigration and emigration of adults and emigration of metamorphs from breeding ponds across a wooded landscape fragmented by turf fields. We documented considerable variation within and among species in their initial departure direction from breeding ponds, which suggests that habitat near breeding ponds has little influence on movement patterns.

Farther from breeding ponds, adults of species that reside in forested habitats during the nonbreeding season (for example, wood frog, spotted salamander [*Ambystoma maculatum*], spring peeper, gray treefrog [*Hyla versicolor*] and red-spotted newt [*Notophthalmus viridescens*]) occurred less often at an ecotone between a turf field and a woodland (Figure 5). In contrast, species that winter in aquatic habitats (for example, green frog, American bullfrog, pickerel frog) readily crossed the turf-woodland edge. Metamorphs of most species tended to be habitat generalists during migration, whereas adults tended to exhibit more habitat selection.