Management Options

An IPM manager uses a mix of preventive and reactive strategies to manage pest problems. Course management decisions and cultural practices are ongoing, while reactive measures are decided and implemented in season. Selecting from a number of management options according to incoming information instead of the calendar is a hallmark of an IPM manager.

Diversification

Diversification of management options is key, using a variety of cultural, biological, physical, and possibly chemical strategies. The case against sole reliance on chemical approaches is obvious because it promotes resistance, and frequent use may subject applicators, golfers and the environment to unnecessary risks. Similarly, reliance on any other single-tactic approaches is also not recommended, because if it fails, damage or turf loss is likely which can also negatively affect water quality. IPM's diversification of tactics allows for multiple layers of protection, and therefore better insurance against pests.

Role of Cultural Management

Turfgrass is a perennial plant system in which cultural practices, especially irrigation, mowing, topdressing, aeration, and venting, greatly affect both short and long term plant health. Healthy plants and soil can better withstand pest pressure. Weak turf can be outcompeted by weeds that take advantage of bare ground or thin turf. Pathogens in particular can take advantage of weak, stressed, or otherwise unhealthy plants and cause disease. Unhealthy plants are also less able to fend off, compensate for, mask, or recover from insect damage. Below are examples of how an IPM approach can be used to for a specific weed, disease, and insect pest issue.

Weed Example

***Poa annua*. *Source:* Jennifer Grant.**

One of the most effective prevention strategies in weed management is to use the appropriate turf varieties for the specific site conditions and intended use on the golf course. For example, a recent development in

some golf courses is the use of tall fescue/blue blends in the rough because heat and drought in the summers create challenges for turf management.

Another concept is to use weed suppressive fine fescues in the roughs, such as Intrigue II and Columbra II that produce allelochemical from their roots. These compounds inhibit the growth of weeds while maintaining a healthy stand of fine fescues. New turf varieties have been developed that provide improved drought tolerance, disease resistance, and have a greater ability to handle foot and cart traffic. In the near future, salt tolerance will be added to the growing list of improved turf varieties as restrictions on high quality water use become an increasing concern for golf courses. Using these improved turf varieties can effectively minimize weed infestation in greens and fairways with low turf density or bare areas.

Tall fescue/bluegrass blend in a rough. *Source:* Bob Mugass, University of Minnesota.

Another effective prevention strategy is to use high quality turf seed that is free of weed seeds. Many suppliers provide a guarantee that states the percentage of weed-free content. The same strategy is useful in determining sod installations for the course as most suppliers guarantee a percentage cover of weed-free sod. The general rule is to purchase high quality seed that is greater than 99% weed free and sod that is 100% weed free, including annual bluegrass.

While prevention is a critical component in weed management, post-emergence control is a necessary part of routine turf management. Many chemical methods for post-emergence control provide rapid, inexpensive eradication of grass and broadleaf weeds. The nonchemical control options include use of thermal weeding technologies, such as propane weed torches, steam wands, and infrared heating devices. These thermal devices can remove patches of weeds or sections of turf for a renovation project. A study conducted at the Royal Quebec Golf Course showed control of *Poa annua* in bentgrass fairways treated with flame weeding using a tractor fitted with burners. The bentgrass was able to recuperate, while *P. annua* declined after one month. Thermal weeding can give stoloniferous or rhizomatous turfgrasses a competitive edge over weeds that grow as bunchgrasses.

Hand weeding is sometimes the most effective and environmentally friendly method of weed management. This photo shows invasive species in the rough. *Source*: Jennifer Grant.

Disease Example

Dollar spot, caused by the pathogen *Sclerotinia homoeocarpa*, is a common golf course disease in New York State. Besides using chemical controls, managers can plan to lessen disease incidence and severity with the following activities:

- Plant resistant cultivars of creeping bentgrass such as Memorial and Declaration.
- Minimize moisture stress and leaf wetness.
- Remove morning dew as early as possible.
- Roll putting greens three or more times per week.
- Apply biological organisms known to suppress dollar spot such as *Bacillus licheniformis*, *Bacillus subtilis*, and *Pseudomonas aureofaciens*.
- Use horticultural oils (Civitas), labeled for the intended use both for treated area and pest, instead of or in conjunction with traditional fungicides.

Dollar spot. *Source*: Jennifer Grant.

Insect Example

Annual bluegrass weevils (ABW) are pests of golf courses in many parts of New York. The only cultural practice known to successfully minimize their damage is to reduce the amount of annual bluegrass in infested areas. In mixed stands of annual bluegrass and creeping bentgrass, as is commonly found on putting greens, practices that favor bentgrass can be promoted. In other areas, it may be acceptable to convert the grass to alternate species such as ryegrass or Kentucky bluegrass. It may also be possible to protect areas by creating a barrier strip of an alternate grass species that deters the spring migration of ABW adults traveling from their overwintering sites to playing surfaces.

Annual bluegrass weevils. *Source:* Jennifer Grant.

Vacuuming has been used to monitor ABW adults in turf, but may also work as a physical and mechanical control practice if done frequently, especially during the spring migration. Biological control methods have been largely unsuccessful in scientific research, but the use of entomopathogenic nematodes may still hold promise.

Beyond the techniques listed, IPM for ABW has relied mainly on careful monitoring of the insect as well as phenological indicators and degree days to target insecticide applications. Pitfall traps, soap flushes, and vacuum sampling detect when and where the adults are moving from their overwintering spots. An insecticide targeting adults is typically timed for the peak migration time. Subsequently, these sampling techniques, along with saline floats that monitor larval development, are used to time the application of an insecticide targeted at 3rd to 5th instar larvae.

Vacuuming to determine annual bluegrass weevil adult presence, location, and movement. *Source*: Jennifer Grant.

Use of Softer and Alternative Pesticides

IPM encourages the use of pesticides as a "last resort" when other methods of pest control prove to be inadequate. However, when pesticides are deemed necessary, an effective product least likely to harm human health or the environment should be selected. Other management options include using an alternative product, such as biological controls or reduced risk pesticides.

Biological Controls

Biological control uses other living organisms to suppress or eliminate pests. Several organisms are known to have some efficacy against turfgrass pests and have been marketed as pest control products. These biological controls may act to suppress pest populations alone or work synergistically with other natural, cultural, physical, or chemical management methods. Examples of biological controls that are commercially available in New York State are provided in the table below.

Biological controls

Beneficial Bacteria	Action
Bacillus licheniformis	Labeled for dollar spot management
Bacillus subtilis	Labeled for management of brown patch, dollar spot, powdery mildew, rust and anthracnose
Pseudomonas aureofaciens (strain TX-1)	Labeled for management of anthracnose, dollar spot, pink snow mold and pythium
Bacillus thuringiensis	Labeled for management of caterpillars in turf. A strain that affects white grubs is known, but not currently commercially available.
Paenibacillus popilliae and *Paenibacillus lentimorbus*	Cause "milky spore disease" and are labeled for management of Japanese beetle grubs in turf. Other strains cause milky spores in other species of grubs, but are not commercially available.
Entomopathogenic Nematodes	**Action**
Heterorhabditis bacteriophora and *Steinernema glaseri*	Effective against white grubs
Steinernema carpocapsae	Effective against cutworms and possibly annual bluegrass weevils

Reduced Risk Pesticides

The EPA defines conventional "Reduced Risk" pesticides as having one or more of the following advantages over existing products:

- low impact on human health
- low toxicity to non-target organisms (birds, fish, and plants)
- low potential for groundwater contamination
- lower use rates
- compatibility with IPM

A number of reduced risk pesticides can be used on turfgrass in NYS. Biological pesticides, which also have many of these desirable characteristics, are classified separately by the EPA.

Reduced risk pesticides

Category	Reduced Risk Pesticide
Fungicides	Azoxystrobin
	Boscalid
	Fludioxonil
	Trifloxystrobin

Herbicides	Bispyribac-sodium
	Carfentrazone-ethyl
	Mesotrione
	Penoxsulam
Insecticides	Chlorantraniliprole
	Spinosad