

Seven IPM Steps

Although IPM permeates all aspects of course management and planning, it can be thought of in seven steps. The steps are sequential, but in practice all are ongoing and overlapping:

- Step 1 – Planning
- Step 2 – Identification and Monitoring
- Step 3 – Course Management
- Step 4 – Evaluation & Analysis
- Step 5 – Intervention
- Step 6 – Record Keeping
- Step 7 – Communication

Step 1: Planning

Many environmental stresses that result in higher pest incidence and severity can be avoided through careful course design and planning, however, most superintendents are faced with managing an existing course. Pest problems and inputs can still be minimized through course modifications and preventive cultural practices.

Knowledge of past pest occurrence, locations (“hot spots”), and management practices are essential as past problems are likely to recur or continue without intervention. The winter months are a valuable time for reviewing pest issues from the previous season, by asking questions such as:

- Can environmental conditions be modified to reduce pest pressure? For example, can trees be removed around a putting green to increase airflow and reduce disease incidence and severity?
- Can traffic be routed to reduce stress? For example, can cart or walking paths be moved to diffuse walk-off areas on a putting green?
- Were monitoring procedures adequate to detect pests early? For example, should pitfall traps be installed to monitor for early season annual bluegrass weevil migration?
- Can pest-resistant grass cultivars be overseeded on any area of the course? For example, a cultivar such as Memorial, a dollar spot resistant cultivar of bentgrass, can be used to overseed putting greens.
- Are cultural practices adequate for minimizing pest problems? For example, would more frequent topdressing decrease anthracnose pressure?
- Have suppliers of new or hard to find products or equipment been identified in order to be prepared to react quickly to a pest outbreak? For example, where can entomopathogenic nematodes for grub control be obtained if needed and desired?

Part of planning is also being aware of new pests. Educational meetings, trade journals, blogs, listserves, and contact with other superintendents and local cooperative extension personnel are usually the best avenues for being alerted. Once a threat is identified, a superintendent should plan how to prevent, monitor, and manage the new pest.

Step 2: Identification and Monitoring

Every course should have a plan for formal pest monitoring or “scouting” of all areas. For example, the frequency should be daily on putting greens, at least weekly on tees and fairways and bi-weekly on roughs.

Whenever possible, the pest pressure should be quantified with measurements such as:

- number of insects per unit area
- disease patch sizes
- percent area affected

Qualitative descriptors such as “high”, “low”, or “very bad” are subjective and difficult to calibrate and track change over time. Photographs also provide excellent documentation and can be used for identification and training.

Once detected, pests must be properly identified and documented, including mapping on an area map and recording the date of the outbreak. This information can be used to build a database for reference in future seasons. Superintendents and staff should continually hone and improve skills by attending training seminars and field days, obtaining reference materials, and providing peer-peer training on problems occurring on the course. Golf course personnel should also know where to send photos or samples when additional expertise is warranted for identification or confirmation.



Soap flushes are a useful monitoring technique. The soap irritates many insects and causes them move out of the thatch and lower plant parts to the tips of grass blades for easier detection and counting. This technique is especially useful for monitoring. *Source: Jennifer Grant.*



Soil cores removed with cup cutters can be searched quickly and easily for the presence of white grubs. The grubs can also be identified for species and life stage. Source: Curt Petzoldt.

Recommended diagnostic laboratory locations include:

- Cornell Cooperative Extension County office (diagnostic labs available in limited locations), http://www.cce.cornell.edu/learnAbout/Pages/Local_Offices.aspx
- Cornell University Insect Diagnostic Laboratory, <http://idl.entomology.cornell.edu/>
- Cornell University Plant Disease Diagnostic Clinic, <http://plantclinic.cornell.edu/>
- Rutgers University Plant Diagnostic Laboratory, <http://njaes.rutgers.edu/plantdiagnosticlab/default.asp>

Step 3: Course Management

Almost every aspect of golf course management affects the likelihood and severity of pest problems. Although practices required for playability sometimes supersede the optimal IPM choice, manipulating cultural practices should be a key part of an IPM approach. For example, low mowing heights used to obtain high ball roll distances on putting greens can be modified by mowing and rolling greens on alternate days to

lessen turf stress while still providing the same ball roll. Similarly, frequent topdressing buries the crown, effectively giving the plant a higher height of cut, while still providing good ball roll. Ultimately, stress-reducing [cultural practices](#) such as these decrease the incidence of disease and reduce weeds, which in turn reduces reliance on chemical pesticides.

Step 4: Evaluation and Analysis

IPM is a knowledge-intensive decision-making system, requiring evaluation of incoming information, such as:

- scouting results
- weather forecasts
- golf course calendar events
- previous pest history and course hot spots
- past pest management success (for example, timing and efficacy of cultural practices, biological controls, and pesticides)
- new information from university research and the experience of peers

By constantly integrating these sources of information, the superintendent can best decide if a pest threat exists, and when, whether, and how it can be avoided or controlled. For some pests, action thresholds will trigger an intervention reaction (Step 5) in season. For others, cultural management strategies may be intensified.

Step 5: Intervention

Intervention is the action taken when pest levels reach the threshold known to cause unacceptable damage or turf loss. In some cases, these thresholds have been determined scientifically, while in other instances these thresholds are based on site-specific experience.

To avoid unacceptable damage or loss, the IPM method relies on an integrated approach using multiple cultural, mechanical, and biological management methods. Using the IPM approach, chemical control is reserved as a last option used only when other methods are insufficient for maintaining acceptable turfgrass quality and playability.

When chemical control is warranted, evaluation and analysis (Step 4) often allows for early intervention, which may result in the use of lower toxicity treatments and spot treatment rather than whole area treatments. An IPM practitioner considers all approaches and selects the least disruptive, but effective, option.

Step 6: Record Keeping

Documentation is key to connecting the elements of an IPM program and increasing its value. In order to be effective, IPM record keeping should exceed legal requirements.

IPM Record Keeping

Record Keeping Category	Record Details
Scouting Records	Pest occurrence, location and severity
	Improvements or increases in pest issues in response to management tactics
Cultural Management Logs	Frequency, timing, location
	Equipment settings, rates (e.g. amount of sand used for topdressing)
	Operator
Weather Conditions	Current
	Forecasted
Pesticide Application Records	All legal requirements such as date, location, product, area treated, and applicator
	Reason(s) for application
	Results
Water Requirements	Monitor soil moisture



Photographs are useful for documenting pest occurrence and damage, and can be compared against past and future photos. *Source: Jennifer Grant.*

Ways to simplify documentation and integration of IPM methods with other aspects of course management include the following:

- Integrate scouting records with mandatory pesticide application records.
- Encourage all staff to report pest sightings and have a convenient method for tracking and sharing this information.
- Use electronic records rather than hand-written records.
- Encourage staff use of tablets and phones for sending data and photos to a central location.
- Use Cornell's TracGolf software program
(http://www.nysipm.cornell.edu/trac/about/about_golf.asp)
- Emphasize scouting records and other IPM information as part of staff training, meetings, and daily communications.

Step 7: Communication

Good communication within the maintenance team is an essential aspect of IPM. Regardless of who monitors pest issues, all staff should be aware of pest problems and management activities and should be encouraged to report observed and potential problems. Furthermore, IPM training should be provided to as many staff as possible.

Communication to golfers, members, administrators, and neighbors is also important. Communicating with these stakeholders lessens the chance of surprises and conflicts and increases recognition of the superintendent and staff as trained professionals that care about protecting the environment. Explaining the IPM approach in personal communications, promotional literature, club newsletters, blogs, and websites helps to advance these goals.