IPM, Monitoring, and Management Plans — A Mandate for the Future

by DR. CHARLES H. PEACOCK and DR. MILES M. (BUD) SMART
North Carolina State University Turf Science Group, Inc.

GOLF COURSE management for the 21st century must be different from the practices of the past. As you plan your golf course management strategies for the 21st century, add three factors concerning the environment to your list — credibility, accountability, and defensibility. Why? Because the public influences environmental laws. Because the public will insist that we protect our drinking water supplies. And because the public expects us, as turf managers, to act responsibly. We must be ready to show them a plan for management, how we evaluate that plan, and the results of that evaluation.

Sustainable Resource Management

Our golf course management decisions must be made based on the principles of Sustainable Resource Management. We define this as a pattern of human activity that can be supported indefinitely. This means it must be synonymous with progress. It also means we must become less dependent on non-renewable resources and that our activities must not have a negative environmental impact.

To many people, golf courses have an image as energy wasters and water polluters. Those of us knowledgeable about turfgrasses can offer many positive environmental influences such as oxygen production, cooling of the atmosphere, absorption of sound and glare, erosion prevention, and effective filtering of natural and synthetic contaminants. Equally, we could offer a second list that touches on the positive attributes dealing with our quality of life. It includes providing areas for popular recreational activities, increasing property values, providing greenspace and wildlife habitats in urban areas, and job creation. Less-informed individuals, and those whose agendas are anti-development or anti-golf, would list the following as negative impacts: destruction of wildlife habitat, sedimentation of wetlands, fertilizer and pesticide pollution, and wasting of valuable water resources.

Dr. Charles H. Peacock

Public Perception

Environmental quality has many aspects. Public perception and attitude are often influenced by the popular press. Consider the following article about the Neuse River, which flows through Raleigh, North Carolina, to the coast:

"City sewage, industrial wastewater, farm fertilizers, livestock manure, and lawn and golf course chemicals are changing the Neuse (River), choking it with nitrogen and phosphorus." — Julie Powers Rives, *Raleigh News and Observer.*

Upon inquiring as to the types of studies into the problems associated with environmental quality and the Neuse River that focused specifically on lawn and golf course problems, it was determined that there were none. The reporter admitted that she was just making a "generalization." The danger here is obvious. The public does not know what is a "generalization" (i.e., we use fertilizers and pesticides on lawns and golf courses, so they must create a pollution problem), and what is good, scientifically valid data that identify a specific problem we must correct. Perhaps environmental issues are being used to block development, whether they have merit or not.

Proactive Response

The response to these problems from the golf course perspective is clear. The industry must be proactive and not only point out the positive benefits, but must also address situations where golf course management intersects with environmentally sensitive areas and develop management strategies that will protect these areas. This proactive approach should include:

- Incorporating Best Management Practices (BMPs) into the design and management of the course;
- Using Integrated Pest Management (IPM) to achieve BMP goals; and
- Using a Risk Assessment approach to develop strategies for protection of environmentally sensitive areas, and using guidelines for pesticide selection based on this assessment.

A well-developed management plan will be thoroughly documented, detailed, and structured. Although some of the types of information may seem elementary at first, all are necessary to accurately construct a useful and realistic management plan. The management plan details your intentions and methods for managing the golf course in a responsible manner. This plan should

include, but not necessarily be limited to, the following:

Site Description and Evaluation: This includes a detailed description of the physical setting, preferably hole-by-hole with the surrounding environment, including drawings and/or aerial photographs (if available) to delineate where concerns must be focused. The description should also include details of the topography and how it intersects with natural areas and interacts with management practices. A general soils map should be included that classifies the native soils according to fertility, percolation, and depth to bedrock and/or groundwater. Surface water features should be described and located. Climate data should summarize conditions that relate to turfgrass growth and how conditions such as temperature, rainfall, potential evapotranspiration, length of growing season, and mean first and last frost dates will impact pest management strategies.

Golf Course Cultural Practices: Mowing affects playability, turf performance, stress tolerance, pest problems, and evapotranspiration. Mowing factors should be considered in terms of species, cultivars, and golfers' expectations. Mowing objectives during optimum and stress situations should be described. Irrigation factors such as slope, type of grass, height of cut, rooting depth, weather factors, soil types, and irrigation system performance should also be documented. Fertilization factors to be addressed should include the use of soil and plant tissue testing, objectives for growth, choice of materials, and environmental consequences. Supplemental practices such as aerification (which could affect pesticide/nutrient loss due to runoff), topdressing/vertical mowing (which affects thatch control and pesticide/nutrient response) and others are also important.

Safety: Details on storage, handling, disposal, and recordkeeping of pesticides related to worker protection, employee right-to-know, OSHA, and other regulations should be provided.

Best Management Practices: The management plan should rely heavily on use of Best Management Practices (BMPs). There are several goals of BMPs:

- Reduce the off-site transport of sediment, nutrients, and pesticides;
- Control the rate, method, and type of chemicals being applied;
- Reduce the total chemical loads by use of Integrated Pest Management, economic thresholds, alternative pest-control methods, and fertility testing.

Examples of some BMPs that can be put into place include:

- Use of vegetative buffers for filtering runoff or sub-surface drainage;

The News & Observer

Raleigh, N.C. Sunday, July 12, 1992

Hidden hazards: Golf vs. nature

Designing a "greener" golf course...

Green course

1. The developer maximizes use of native vegetation and grasses, which are more resistant to disease than exotic plants and require less watering and use of fungicides.
2. Course conserves water supplies by "spray irrigation," wastewater from its own treatment plant or retention ponds, rather than pumping fresh water out of streams or the ground.
3. By preserving wetlands and other sensitive acreage, designer maintains wildlife habitat and provides "buffers" for pollution runoff into the waterways.

...or a golfing development

Brown course

1. Fairways and houses are built on the edge of streams or other waterways, increasing the chance of lawn chemicals draining into waterways.
2. The design ignores natural contours of the land, requiring massive earth-moving and higher potential for silt running off the land.
3. Groundskeepers use highly toxic chemicals, such as chlorinated compounds, to fight pests and lawn diseases. Such chemicals take longer to degrade, and can kill birds and other wildlife.

Fraser Van Aacht/The News & Observer

Greens mean gold to developers; environmentalists are seeing red

By STUART LEAVENWORTH
Staff writer

This weekend, thousands of North Carolinians will hit the golf course, driving tiny balls down tree-lined fairways, riding their carts past glassy lakes that border green carpets of lush grass.

Amid the trees and water, few may suspect that their golf pursuits cost anything more than money. But as more and more courses are being built, environmentalists say the layouts are disrupting wildlife, destroying wetlands and promoting an overuse of pesticides, fertilizers and bulldozers.

Golf course construction has been particularly strong in North Carolina, where 115 new courses have opened since 1980. Nationwide, North Carolina ranks ninth in total courses with 484 in place and 23 more under construction.

"Even in the best of circumstances, golf courses have a tremendous impact," said Millie Buchanan, an Asheville environmentalist who has been fighting golf courses planned around trout streams. "You are using a lot of land, you have chemical runoff. When you have a developer who is not committed to doing things right, it can be a real disaster."

Environmentalists acknowledge that golf courses do not rank with toxic dumps or polluting factories. But they say two trends in course design and development are moving golf up the list of environmental concerns.

First, developers have been seeking out spectacular backdrops — mountain streams, coastal marshes — and have been adorning their courses with features like bent grass greens, which require more pesticide spraying than greens of other grasses.

Second, the pattern of combining country clubs with high-density residential developments means that a new golf course usually involves a lot more than 18 holes and a clubhouse. More ground must be broken, more sewage treated and more storm-water runoff channeled. The combination of fairways and residential lawns also increases the amount of pesticides and fertilizers that can threaten waterways.

Concerned that the pollution debate could damage golf's image, the U.S. Golf

See NATURE, page 6A

■ **Pesticide use:** Disclosure by golf courses not required, page 6A.

■ **Water pollution:** Fertilizer runoff poses threat to tidal creeks, page 6A.

Test time: Golfers wait while Ron Hall, superintendent at Governors Club, takes a soil sample from a green to be tested for diseases

Staff photos By Jim Bourdier

Public perception regarding golf courses and the environment varies widely and is often influenced by the popular press.

- Planting of more pest-resistant or stress-tolerant cultivars;
- Culturally or biologically controlling pests;
- Using soil testing and plant tissue analysis to help determine nutritional requirements.

There are many other examples that can be applied to meet the BMP goals as stated above.

Integrated Pest Management: Strategies for Integrated Pest Management (IPM) have been applied in agriculture for more than 30 years. Recently, the U.S. Department of Agriculture has launched an initiative to implement IPM methods on 75 percent of the total crop acreage by the year 2000. The U.S. Environmental Protection Agency supports this effort, and the Office of Pesticide Programs has been instrumental in helping golf course superintendents find ways to incorporate IPM strategies into their programs. The definition of IPM as put forward by the Responsible Industry for a Sound Environment (RISE) is as follows:

"A system of controlling pests in which pests are identified, action thresholds are considered, all possible control options are evaluated, and selected controls are implemented. Control options — which include biological, chemical, cultural, manual, and mechanical — are used to prevent or remedy unacceptable pest activity or damage."

The choice of control options is based on:

- Effectiveness
- Environmental impact

- Site characteristics
- Worker/public health and safety
- Economics

The basic components of IPM are **1) monitoring** — of potential pest populations and their environment; **2) determining** — pest injury levels; **3) decision making** — developing and integrating all biological, cultural, and chemical control strategies; **4) educating** — personnel on all biological and chemical control strategies; **5) timing and spot treatment** — utilizing either chemical, biological, or cultural methods; **6) evaluating the results** — an ongoing process. This necessitates that the turf manager and people involved in the IPM program have a thorough knowledge of turf and its pest problems, that there be a structured monitoring or scouting program, the intensity of which is determined by the value of the area and a knowledge of pest life cycles, and that detailed records are kept to measure the effectiveness of the program and serve as a basis for making future decisions. IPM is an evolutionary process.

Changes to the program are continually made as information is collected about the golf course, as new information on strategies for control becomes available, and as the options for control change.

There are six basic approaches for turf protection using IPM. They are: **1) regulatory** — using certified seed, sod, and sprigs; **2) genetic** — selecting the best adapted species/cultivars for the location; **3) cultural** — a healthy grass means fewer problems; **4) physical** — isolating areas where pests are a problem; **5) biological** — favoring natural competition; and **6) chemical** — which is selective, but may be necessary.

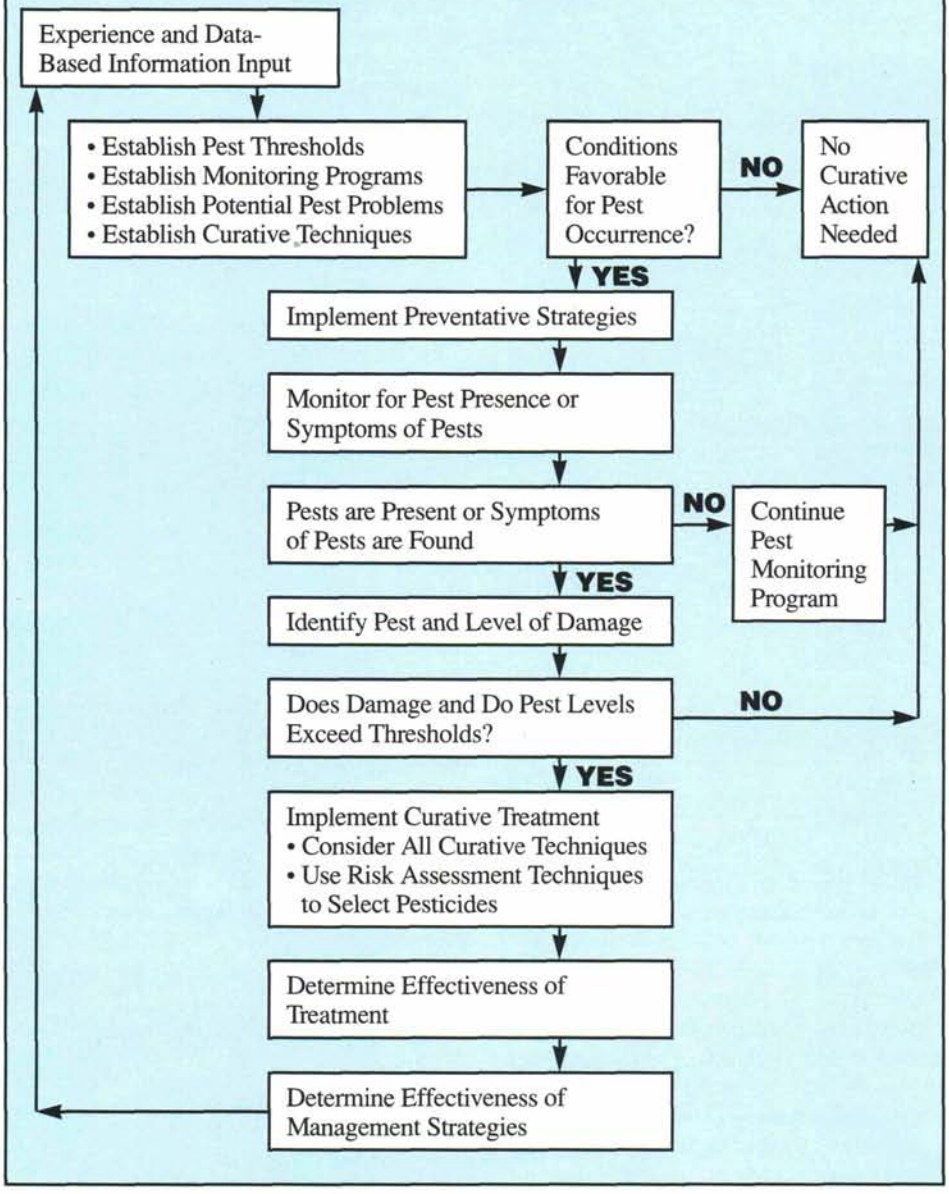
Selecting Thresholds

One of the critical strategies to an IPM approach is to set thresholds for pest problems and to use control treatments only when they are exceeded. This requires vigilant scouting by qualified personnel who are trained to recognize the pest problem at an early stage. Thresholds for insect pest problems are in many instances determined by location, since only a few insect problems are found uniformly across the country. Watschke et al. (1994) recommend insect thresholds for some of the more common problems as follows:

Insect	Threshold Number per Square Foot
White grubs	6 to 10
Sod webworms	5 to 10
Cutworms	
Fairways	0.5 to 1
Greens	1 per square yard
Skipper larvae	0.5 to 1
Chinchbugs	25 to 30
Black turfgrass Ataenius	>50
Asiatic garden beetle	>20

Establishing threshold levels for insects provides guidelines to the golf course superintendent. Control treatments are used only when the threshold level is exceeded.

Figure 1 — Integrated Pest Management Decision Flow Chart



These are also largely determined by the value of the area and the recuperative capacity of the turf. Information on the biology of insect problems common to your area should also be included in an IPM plan. For example, there is a degree-day model on billbug larvae and adults which uses climatic information on which to base the scouting program and plan the most effective treatment schedule.

Disease thresholds are less well defined and depend to a great extent on the turfgrass species, prevailing environmental conditions, economic or aesthetic value of the site, and the cost of chemical treatment versus renovation of damaged turf sites. Disease thresholds may also be based on previous history of infection at the site, particularly for problems such as spring dead spot, take-all patch, and summer patch. Similarly, weed problems can be handled with the same objective in mind.

A structured program is very important for success of the IPM program. Monitoring should be set up to use designated scouts (which should include the superintendent), detailed records should be kept, and results should be continually evaluated.

Risk Assessment

Risk assessment is the process of assigning magnitudes and probabilities of effects to ecosystems resulting from human activities or natural phenomena. The risk assessment protocols include procedures that characterize the source of the risk, the ecological resources at potential risk, the magnitude of the hazard, the exposure potential, and the assessment of risk.

Selection of Pesticides — Pesticides selected for use in golf course management should emphasize localized application of highly specialized materials that act quickly, effectively, and which then naturally and quickly are degraded. Pesticide characteristics of interest include toxicity, persistence, fate, mobility, and leaching potential. Selection of materials should be based on a screening risk assessment that includes characterization of the site, management practices, and chemical properties of materials; screening models; and in selective cases, computer simulation modeling.

Screening models use chemical properties of the pesticides as the basis for predicting whether pesticides will move in the environment. Data on the chemical properties of pesticides are found in the *USGA Green Section Record* (Kenna 1995) and in Wauchope et al. (1991). Several useful screening models for leaching potential include the GUS (Groundwater Ubiquity Score, Gustafson 1989) and PLP (Pesticide Leaching Potential, Warren and Weber 1995); and for surface runoff, Augustijn-Beckers et al. (1991) and the SCS screening rating provide information on movement (Goss 1991).

A list of pesticides appropriate for the site should be developed from this type of analysis. Based on the receptors on the property, restrictions for use of certain materials should be made where appropriate.

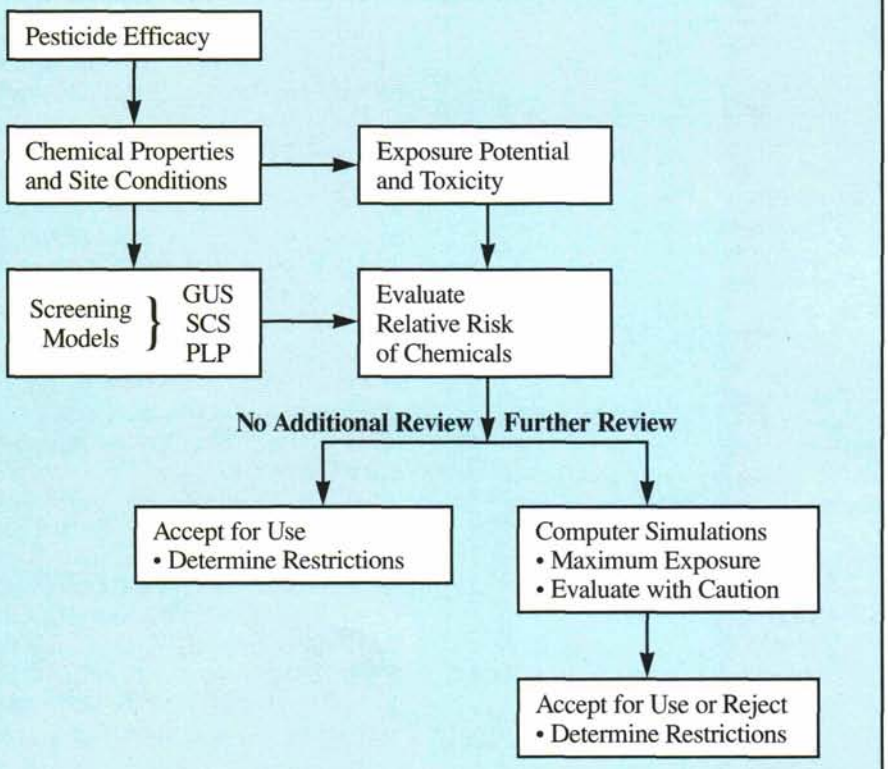
Computer simulation models attempt to predict the fate and transport of pesticides from golf courses to various environmental receptors, such as surface water and groundwater. Computer simulation models are not frequently used because they have not been calibrated for turfgrass situations. When compared to field measurement, computer simulations have overestimated the movement of materials (e.g., Kenna 1995). Results from computer simulations must be interpreted with caution.

Monitoring

Monitoring programs focus on two objectives: the IPM objective and the environmental objective. The **IPM objective** is to determine if pest populations are building to a threshold level that requires implementation of some form of control; the **environmental objective** is to determine if any environmental impact is occurring.

Monitoring for golf agronomic purposes can be grouped by frequency. There are those items that may need to be monitored on a daily basis, such as quality of cut, soil moisture, disease incidence, and weed infestation; on a weekly basis, such as soil temperatures, tissue nitrogen concentrations, algae and moss infestation, and the presence

Figure 2 — Pesticide Selection Process for Integrated Pest Management



of hydrophobic soil problems; on a monthly basis the soil profile should be examined for presence of fungi, compaction, infiltration rate, and soil pH, and the irrigation system should be checked for calibration; and at least annually a complete soil analysis should be performed, drainage should be evaluated, and air movement and shade should be checked. The determination of timing on these and other factors may vary due to location, soil type, and turfgrasses in the area. Some form of structured program should be in place to collect information to help in making management decisions.

Monitoring for environmental purposes generally has three goals: 1) establish a baseline of environmental quality; 2) provide data that will establish environmental conditions, thus providing a basis for measuring compliance with environmental regulations; and 3) ensure that IPM is functioning properly and that no health hazards have developed. Environmental monitoring is usually conducted in phases. For example, three phases are associated with a new golf course: pre-construction, construction, and operational phases. Each phase has specific goals and objectives and is integrated with the other phases.

The focus of environmental monitoring is generally on surface water, groundwater, and surficial sediments, but habitat monitoring is increasing. When conducted, habitat monitoring focuses on maintenance of terrestrial and aquatic habitat and, currently, is most often associated with wetlands and forested areas.

A monitoring program must be scientifically based so that it produces defensible data about golf course operations. One can rely on the data to make decisions about compliance with regulations; if non-compliance events are detected, then steps can be taken to correct those situations. Having data that demonstrate regulations is a powerful tool for confirming that a golf course is not having a negative impact on natural resources.

Results of environmental monitoring programs provide feedback to the superintendent and are useful management tools. Results also provide written documentation of the effect of the golf course on the environment.

Audubon Cooperative Sanctuary Program

An additional option, as part of the overall management plan and strategies, is to participate in the Audubon Cooperative Sanctuary Program. The whole approach to the Audubon program is to promote sound land management and conservation of natural resources, incorporating every aspect of the use of BMPs and IPM. Additionally, it encourages the superintendent to take a leadership role in conservation projects, and recognizes golf courses for their efforts. Under this program, everyone should work towards gaining certification in the areas of environmental planning, public involvement, wildlife habitat management, water quality management, and integrated pest management. These are not just critical achievements from a public relations perspective, but they promote and document good stewardship on your golf course.

And Finally . . .

The benefits of a management plan that incorporates all of the components of BMPs and IPM into your golf course management programs are threefold:

- Assures more judicious use of pesticides/fertilizers
- An economic savings
- Positive public relations over environmental concerns and less negative environmental impact.

IPM strategies have been successfully employed at thousands of golf courses around the world. Documentation of these efforts and a plan for conducting the program and evaluating the results is often lacking. Take time today to make this a priority. Remember the "whys" of planning — **credibility, accountability, defensibility.** Have you done everything you can to make your approach to golf course management environmentally responsible, and can you document it?

References

Augustijn-Beckers, P.W.M., T. M. Butler, A. G. Hornsby, L. B. McCarty, D. E. Short, R. A. Dunn, and G. W. Simone. 1991. Managing pesticides for crop production and water quality protection: Turf — golf courses. Circular 1011. IFAS, University of Florida, Gainesville, Florida.

Goss, D. 1991. Screening procedure for soils and pesticides relative to potential water quality impacts. In *Using Computer Simulation Models in Pesticide Registration Decision Making.* A Symposium/Workshop. Weed Sci. Soc., Louisville, Kentucky.

Gustafson, D. I. 1989. Groundwater ubiquity score: A simple method for assessing pesticide leachability. Environ. Toxicol. Chem. 8:339-357.

Kenna, M. P. 1995. What happens to pesticides applied to golf courses? USGA Green Section Record 33:1-9.

Warren, R. L., and J. B. Weber. 1994. Evaluating pesticide movement in North Carolina soils. Soil Science Society Proceedings, North Carolina 37:32-35.

Watschke, Thomas L., Peter H. Dernoeden, and David J. Shetlar. 1994. Managing Turfgrass Pests. Lewis Publishing Co., Boca Raton, Florida.

Wauchope, R. D., T. M. Butler, A. G. Hornsby, P.W.M. Augustijn-Beckers, and J. P. Burt. 1992. Review of Environmental Contamination and Toxicology. Springer Verlag, New York.