GOLF COURSE/LANDSCAPE INTEGRATED PEST MANAGEMENT

David G. Nielsen, Professor
Department of Entomology
The Ohio State University, OARDC
Wooster, OH 44691

Introduction:

Discussions of Integrated Pest Management (IPM) are commonly introduced by the speaker proclaiming that there are probably as many definitions as there are those who consider the subject. The time for that mind-set has passed. There has been enough said about IPM during the past 30 years in enough circles and forums that most of us understand the concept and its intent. For the purposes of clarity, I'll define **IPM** as *a common sense approach, using environmentally conservative methods to maintain pests below defined economic or aesthetic damage levels. Targeted intervention tactics are used, based on monitoring plant vitality and abundance of pests and their natural enemies. In short,* ***IPM is an informed decision-making process that results in efficient risk reduction.***

Specialists who are asked to discuss IPM invariably emphasize their particular area of expertise, often at the expense of a balanced analysis of the concept itself. Entomologists tend to emphasize arthropods, with some justification, since insects and mites commonly account for up to 70 percent of pest problems encountered in landscape management. However, if we are truly interested in IPM as the paradigm for golf course and landscape managment, we must also consider diseases, weeds, rodents, and cultural problems that reduce plant vitality and longevity.

Basic Components of IPM:

There are a number of components in any IPM program that must be addressed before implementation is possible. Some of the most important of these are listed below. The IPM practitioner must:

1. Determine which key plants are commonly injured by presence of weeds, arthropods, or pathogens, or are weakened due to cultural problems.

2. Determine key pests (arthropods, diseases, rodents, weeds) and cultural problems that damage landscape plants.
3. Define the management unit for the program.
4. Develop plant inventory and pest/problem survey protocols.
5. Develop efficient sampling methods for all pests and cultural problems.
6. Define action thresholds for all key pests.
7. Establish a monitoring program.
8. Design a pest management plan for each key pest/problem.

Explanation of Components:

1. Key Plants: Several studies have shown that relatively few tree and shrub species harbor most of the pest problems encountered in landscapes. These taxa can be considered as key plants for the purposes of IPM. However, other apparent plants or groupings (i.e., specimen plants and foundation plantings in conspicuous areas) that contribute significantly to the value of the landscape may also be considered as key plants for monitoring. Experienced arborists know which kinds of plants require intervention tactics (pest control or cultural practices) on a regular basis. This knowledge is useful in determining which plants must be inspected most closely and regularly to ensure that pests do not cause damage before intervention (remedial action) occurs. Although the list of key plants will vary geographically, in most areas a small number of plants will be listed as both apparent in the landscape and susceptible to infection or infestation on a regular basis. This knowledge is comforting to arborists who may otherwise be overwhelmed by the idea of needing to spend a lot of time inspecting every plant on the property during each monitoring. In fact, although many landscape plants are susceptible to some pest species, most trees and shrubs serve as hosts for only a few key pests capable of causing severe aesthetic or physiological damage in a short time.

2. Key Pests: Key pests can be defined as common, ubiquitous organisms that threaten the vitality or aesthetic value of key plants. These pests range from secondary-action organisms like shoestring root rot fungi and two-lined chestnut borer that exploit weakened trees, to apparently aggressive species like vascular wilts, armored scales, and clearwing moth borers. Although there are many arthropods on nearly all plants during the growing season, few of them are capable of causing enough immediate injury to threaten the longevity and beauty of vital plants. Healthy deciduous trees and shrubs can withstand the feeding activities of hundreds or even thousands of individual sucking insects and mites and occasional defoliation caused by microrganisms or arthropods. Many times, aphids and soft scales cause more problems through excretion of honeydew than from their impact on the physiological processes of host plants.

Landscape managers must determine which key pests in their geographical area justify significant management inputs, including cultural and other, more direct intervention activities. Usually, this list of key pests will be short enough to allow practitioners to become thoroughly familiar with each pest, including its host range, damage potential, biology and seasonal life history, vulnerability to management tactics, and ways to monitor its presence and abundance efficiently.

Any list of key pests for an IPM program is not complete without consideration of cultural problems associated with plants growing off-site or in confined areas where they cannot be expected to survive or thrive without additional inputs in the form of cultural manipulation. For example, junipers growing in shade will never realize their full potential; pin oaks growing in high pH soils will always be subject to chlorosis through limited availablity of iron; dogwoods in full-sun will be predisposed to colonization by dogwood borer; taxus plants will never thrive in poorly drained soils.

3. Management Unit: All woody plants on small properties with limited plant diversity will usually be included in the management unit for landscape IPM programs. Even on these properties, most monitoring will be focused on key plants. As property size and plant diversity increase, it may be prudent to *define the management unit as that portion of the property scheduled for intensive monitoring to maintain apparent plants in a vital condition.* Other key plants may be included, depending upon consumer expectations and demands. However, woodlots on larger estates, golf courses, and institutional properties will be managed differently than trees and shrubs in the defined management unit.

4. Inventory/Survey: After determining which plants and pests/problems are most important in the geographical area, the IPM practitioner must become familiar with plant and pest/problem identification. A plant inventory-pest survey is then conducted. The inventory should include plant species, a numerical assessment of each key plant's vitality, its age or size, and its location on the property. The best approach is to chart the location of all key plants in the landscape on a map to facilitate monitoring and other aspects of IPM, including information retrieval and scheduling. Presence of all pests and their density, cultural problems, and other factors that influence inplementation of IPM should be recorded.

5. Sampling Methods: Each problem included in the list of key "pests" represents a challenge in terms of efficient sampling to determine pest presence and severity. Soil should be sampled and evaluated to measure porosity, organic matter content, pH, and mineral element status. These tests should become routine and be implemented following guidelines provided by a local analytical laboratory. Local labs are familiar with local soil conditions, and process samples accordingly. Personnel in departments of agronomy indicate that distant labs may be competent, but their results can be erroneous, based on lack of familiarity with local site conditions and associated requirements for accurate analyses.

Key plant diseases like apple scab and fire blight may need to be managed using preventive application of fungicides in areas where scab and fire blight are common problems. Conventional sampling may be inappropriate in these cases, because by waiting until infection occurs, it is too late to implement a control tactic that will provide an acceptable level of plant quality. However, even with these kinds of pests, plant materials need to be identified accurately so that only susceptible species and cultivars are treated. This, too, is a form of sampling: Inspection of trees and shrubs to determine their identity to avoid using intervention tactics unnecessarily.

Knowing where to expect problem arthropods, in terms of plant material and location on the plant, and the ability to make field identification of key pests, is essential for reducing the amount of time required for sampling. Accurate records of all sampling activities, including the time required to implement individual sampling procedures, must be kept in a readily retrievable form. This information, combined with an evaluation of plant vitality, can be used to fine-tune action thresholds.

6. Action Thresholds: The IPM approach implies a willingness to accept some level of pest presence. Instead of trying to maintain a pest-free landscape, plants are managed to reduce their susceptibility to colonization and vulnerability to damage. Pest species and cultural problems are monitored routinely to ensure they do not reach damaging levels on key plants before corrective measures are instituted.

Woody plants can support low-level infestation by many kinds of pests without incurring significant injury or having their aesthetic value reduced. The ***action threshold* (AT)** *can be defined as the level of pest density at which some form of intervention is justified to prevent unacceptable aesthetic or physiological impact on the* *plant*. Of course, the AT for a given pest or problem will be dynamic and influenced by plant vitality, time of the year, local weather conditions, historical information about pest/problem impact in the area, and expectations of consumers. When the AT has been reached, either cultural practices are used to enhance plant vitality or to reduce the quality of the environment for the pest, or direct pest control tactics are used to reduce pest abundance.

Although the AT's for most landscape pests have not been determined through experimentation and validation, this should not discourage use of the concept in IPM. In fact, many practitioners and homeowners use this approach without giving it much thought, whenever they detect pest presence but decide the infestation or problem is not severe enough to warrant intervention measures. Recognizing that intervention tactics should be used only when they can be justified on the basis of threat to plant quality, serious consideration must be given to establishing base-line AT's when designing IPM programs. This is the only way the concept will ever be incorporated in the decision-making process. Prescription landscape pest control has already been implemented in Canada and will probably be mandated in the U. S. in the near future.

Realistically, the only way to get started using this concept is to initially make arbitrary decisions about AT's for each pest/problem. Then, careful records must be kept while monitoring, including the number of pests per unit area of plant (e.g., aphids/leaf; scales/meter of branch, etc.). At the same time, there must be an estimate of plant vitality. In time, it will be possible to correlate plant vitality and pest numbers, permitting fine-tuning of AT's. Record-keeping and experience will be required to develop meaningful thresholds for each pest on different plants at specific times of the year. In many cases, aesthetic damage occurs before pests cause measurable plant injury. Consequently, aesthetics play an important role when establishing AT's for golf course and landscape IPM.

7. Monitoring: Monitoring is the most expensive part of any IPM program, so its efficiency needs to be maximized. The best way to begin developing an efficient monitoring program is to focus planning activities on key plants and key pests/cultural problems. Then, biological information about these plants and pests is analyzed to determine the time of year when sampling is most efficient. For example, some lepidopterous defoliators and all scale insects that overwinter on deciduous hardwoods can be assessed most easily during the dormant season. All IPM programs should include one monitoring visit during the winter.

Soil sampling can be accomplished during late summer or early fall when other IPM activities have diminished. Determining the need for cultural practices at this time will permit timely implementation of tactics like fertilization and aerification to have the greatest impact on plant vitality.

Some practitioners beginning IPM programs believe they need to inspect each plant on the property during each monitoring visit. However, groupings of even high-value plants may be considered as individual plants, in terms of scouting effort, if they are comprised of one species and their branches are interdigitating. The most efficient way to handle such groupings is to monitor different plants within the grouping during different inspection periods.

All monitoring visits should include the following kinds of information: the individual plant or plant grouping (If you are mapping plants and have assigned them numbers, the best way to identify them is by referring to the appropriate number); numerical vitality rating; pests or cultural problems and their intensity or severity; damage symptoms; stage of pest or disease development; presence and abundance of pests' natural enemies, including ladybird beetles, lacewing and hover fly larvae, and preying mantids, etc.; assessment of results of previous intervention tactics or cultural practices; general comments. This information, recorded systematically over a period of several years, will enable critical program evaluation and improvement. A simple form, specifying categories for this information, along with a place for the date of the monitoring and the location and identification of the property and its owner/manager, is an important tool in this process.

8. Pest/Problem-Specific Management Plans: This IPM component requires the program manager to determine how each problem encountered will be addressed, before the problem is identified during an inspection. Once a short list of key pests is developed, all available management options can be explored, and decisions made about how to deal with the pest under various circumstances that may be encountered. For example, foliage and bark sprays may be used to control bronze birch borer on susceptible landscape trees. However, if borer control is indicated for birches growing near ponds or other waterways, microinjection can be used to prevent contamination of sensitive non-target areas. If bronze birch borer is a serious pest in the area, and you know that you will occasionally be dealing with birches after they are already borer-infested, then it will be important to either become competent in trunk injection technology or to develop liaison with someone who can provide this service on a timely basis. Then, cultural practices can be implemented to reduce susceptibility of trees to recolonization by the borer.

Knowledge that soil compaction or high pH are serious impediments to plant health in your geographical area, provides time to learn about tactics that can be used to solve or minimize these problems before an IPM program is implemented. If apple scab is annually a problem on susceptible cultivars of flowering fruit trees, then a phytopathologist can be consulted to determine the most efficient way to use preventive treatment to minimize scab damage. Whereas orchardists must use numerous sprays to manage scab infection of leaves and fruit, landscape managers can provide adequate foliage protection using only two well-timed applications of an effective fungicide.

After management plans have been developed for all pests and cultural problems that are expected on key trees and shrubs, these plans must be integrated to minimize duplication of efforts and to maximize efficiency of the IPM program. When appropriate, even turfgrass pest and cultural problem management plans can be integrated with those for trees and shrubs to develop truly holistic landscape IPM programs. This process of integration of management plans is the most time consuming part of the planning process. But, it is also the part of the program that brings all previous planning together in the form of usable strategies for state-of-the art, integrated landscape plant management.

This approach to golf course/landscape management will dramatically alter the inputs involved with pest control. In all cases, pesticide usage will be rational, based on acknowledged need. Conventional or so-called biorational pesticides (= environmentally conservative pest control products) will be used properly: proper timing to maximize influence on the pest population and to minimize the need for re-treatment; proper sprayer and spray technique to get the toxicant to the target, while minimizing non-target impacts. In most cases, well-timed and thoroughly applied spot treatments will provide an acceptable level of control with minimum impact on natural enemies and other non-targets, including humans. Experience has shown that when pesticide use is minimized in the landscape, natural enemies of arthropods often flourish, thereby stabilizing many pest populations below the action threshold.

The value of implementing IPM as part of a plant health care program is that there will be few surprises or questions about procedures; decision-making will become more objective, and pest control and cultural practices can be implemented on a timely basis to reduce costs while maintaining plant vitality. Also, biorational products will often be effective because timing of their use against moderate pest pressure will be precise.

Some specialists have suggested that there is not enough information regarding the biology and ecology of the major pests of ornamental plants to allow implementation of workable IPM programs. Surely, this is not so. Admittedly, little is known about how horticultural practices directly influence plant physiology and vitality and how this is translated into resistance or susceptibility to pests. However, a great deal of biological information is available for nearly all of the key pests that inhabit landscapes throughout North America. The critical need is to package this information in a way that is understandable and readily usable by practitioners. Hopefully, this will be done in the context of Plant Health Care.