JOURNAL OF
ARBORICULTURE

October 1987
Vol. 13, No. 10

INTEGRATED PEST MANAGEMENT IN THE NATIONAL CAPITAL REGION OF THE NATIONAL PARK SERVICE

by James L. Sherald and Carol L. J. DiSalvo

Over the last seven years the National Park Service (NPS) has developed an exemplary IPM program. The National Capital Region (NCR) played a major role in leading the NPS transition to IPM. The NCR IPM program reduced pesticide use and, most importantly, has created an enhanced awareness of the relationship between pest management and other aspects of resource management. An overview of the program and some general perceptions of how and why IPM should be applied to park systems is the purpose of this article.

NCR is a diverse park system of approximately fifty thousand acres consisting of natural, historical, recreational, and urban landscaped parks. Inherently, these diverse resources present a wide array of pest management issues. Although the IPM program addresses all pests including household, structural, and agricultural, the most challenging area is the management of pests affecting ornamental landscapes such as the National Mall and monument grounds of Washington D.C.

Prior to 1979, NCR's approach to pest control was, as in many park systems, a conventional chemical approach relying on routine applications of pesticides to both real and assumed pests. The impetus to change to IPM came simultaneously from environmentalists concerned about the use of pesticides in heavily visited parks, employees concerned for their health, and managers questioning the efficacy and necessity of some pesticide projects. In 1979 we initiated a complete review of all pest problems, particularly those involving pesticides. The John Muir Institute, Inc. (JMI), Napa, CA, was contracted to assist NCR in reviewing its pest management program and in making the transition to IPM. A three-year contract with JMI was initiated in 1979. Since the pilot project, IPM has been expanded and managed by the pest management division of NCR's Center for Urban Ecology (CUE).

IPM Components

Managers responsible for the diverse resources of park systems, municipal landscapes, campuses, military bases, and planned communities can be overwhelmed by the diversity and complexity of pest problems. The uncertainty and concern that many managers experience generate an impluse to apply pesticides. IPM tempers uncertainty by providing a frame of reference applicable to all pest problems. The IPM approach is a "decision making process" (1) encompassing a broad understanding and measure of the pest, the threatened resource, and all factors affecting the pest/resource complex. The IPM approach can be focused into six major components (Fig. 1).

Information. Only when a pest is identified and its biology understood can a manager assess the threat and determine the appropriate management strategy. Sometimes an organism is relegated to "pest" status because it is not immediately recognized. For instance, several of our employees were once alarmed by large, light-green caterpillars which were harmless larvae of the *Cecropia* moth.

The pest or agent responsible for damage is not always apparent and action should not be taken until the cause is known. Browning of creeping juniper, *Juniperous horizontalis,* can be caused by mites, scale, tip moths, fungal pathogens, and abiotic factors such as poor drainage. Each factor would be approached differently. For example, tip blight caused by the fungal pathogen *Phomopsis* can be controlled with fungicides, while Kabatina blight can only be managed with resistant varieties. In each case the symptoms must be examined closely and if a pest is involved, it must be identified.

In addition to the identity of the pest, an understanding of its biology is critical in targeting the most vulnerable aspects of its life cycle and developing the most effective management strategy. Wax scale, for example, is most effectively controlled with insecticides applied just as crawlers emerge in mid-June. Buprestid borers are attracted to trees and shrubs under environmental or biotic stress. Managers who understand this aspect of their biology will focus on preventing or alleviating stress rather than simply applying pesticides for borers, which are often the *coup de grace* for plants beyond hope of recovery.

Unfortunately, the opportunities to examine a pest both through a hand lens and through the literature are not always available or appreciated by those responsible for pest management. Consequently, training, formal and informal, at all levels is an essential element in any IPM program. (Fig. 2)

Inspection and monitoring. Close, continuous assessment of the site/pest complex is the focal point of all IPM programs. There are two aspects to the assessment: inspection and monitoring. Inspection affords the opportunity to find and interpret the interaction of all factors that may directly or indirectly affect the pest problem; *eg.* pest, host, predators, parasites, management practices, and planting history.

It is through inspection that key components can be selected for monitoring. Monitoring requires repetitive measurement of components, such as the pest population, which can provide a quantifiable and meaningful assessment of the problem.

Most IPM monitoring techniques have been developed for agricultural pests. The lack of well-developed techniques for urban landscape pests, however, should not discourage managers from developing their own procedures. Simple random sampling, counting and recording of the pest, pest damage, and other key components can provide data for: 1) comparing infestations from year to year, 2) establishing acceptable thresholds, 3) determining if treatments are necessary, 4) timing of treatments to the most vulnerable stage of the pest, and 5) evaluating the efficacy of treatments.

When there is a continuous recorded history of

Figure 1. IPM components

1. **Information**
   Accurate identification of the "pest".
   Comprehensive understanding of the biology of the pest, its natural controls, and its relationship to the threatened resource.
   Training.
2. **Inspection and monitoring**
   Site inspection to appraise the site/pest complex and to choose meaningful, quantifiable monitoring components.
   Routine sampling of monitoring components, e.g. pest, pest damage, natural enemies, activities contributing to the pest problem.
   Record keeping and analysis of sampling data.
3. **Development of action plan**
   Establishment of injury and action levels.
   Selection of management strategies and tactics.
   - Chemical controls
   - Physical controls
   - Biological controls
   - Horticultural controls
   - Habitat modifications
4. **Action**
   Implementation of management tactics and strategies in conjunction with monitoring.
5. **Evaluation**
   Analysis of monitoring data.
   Adjustment of injury and action levels.
   Adjustment of management tactics and strategies.
6. **Prevention through design and redesign**

a pest problem, new managers are not burdened with the necessity of starting from scratch in their interpretation and evaluation of the problem. For example, continuous monitoring and recording of the Dutch elm disease incidence on the National Mall for forty years alerted managers to a rise in the disease incidence in the 1970's sparking an enhanced city-wide sanitation program (3).

Monitoring, as demanding as it may appear, is essential in minimizing poor management decisions based on superficial judgements derived from subjective and often inaccurate evaluations.

Development of action plan

Injury and Action Levels. An injury level is an established level of a pest infestation in a crop above which economic damage will occur. The action level is the level at which it is economically advisable to apply control measures to avoid reaching the injury level. Injury and action levels have been established for many agricultural pests and are commonly used in directing agricultural IPM programs. In the management of pests in amenity landscapes, we do not have many established levels to guide control programs. Many pests affecting ornamental landscapes impose aesthetic damage long before plants are destroyed and economic loss is realized. Aesthetic impairment of ornamentals is far more difficult to measure than crop loss. Moreover, little research has been directed toward the establishment of injury and action levels for ornamental and shade tree pests.

Although specific thresholds may not be established, landscape managers should at least be aware of the concept and understand that the mere presence of a pest does not necessarily require control. We have seen many situations where pesticides were applied to pests that were present in very small numbers causing no aesthetic damage much less debilitation of plant health.

The challenge facing managers is in determining how many Japanese beetles per tree, how many azalea lace bugs per shrub, or how many dandelions per square foot can be tolerated before action is necessary. It is only through experience and objective monitoring of the pest and the damage that managers will become comfortable with the concept of accepting a tolerable level of infestation.

Managers can set arbitrary levels as bench marks or goals. However, levels should always be recognized as arbitrary and subject to change as the perception of the pest and the impact it has on the aesthetics and health of the plant are better understood. Research is needed to develop monitoring procedures and action levels for ornamental and shade tree pests.

Selection of Management Tactics and Strategies. Strategies are often composites of various tactics that will suppress the pest and the injury they cause. The tactics used in pest management are well known: chemical, physical, biological, horticultural, and habitat modification.

There is often a tendency to proceed directly and exclusively to pesticides. Although pesticides frequently provide immediate relief, their effect is often short-lived. Consideration should always be given to other approaches which alone or collectively will manage the problem and provide lasting control.

Rat mangement in Lafayette Park, across Pennsylvania Avenue from the White House, was a frustrating and losing effort prior to the demonstration program initiated by the JMI (2). Rats were aesthetically unacceptable and were destroying tulip bulbs. Control based exclusively on the use of rodenticides was having little-to-no effect as in-

Fig.2. National Park Service employees receiving training in the field.

dicated by the monitoring data gathered prior to the IPM program (Fig. 3). Once additional tactics, such as removal of overgrown vegetation and improved trash containers and collection became part of the strategy, the rat population declined. The monitoring of open/active rat holes as an index of the population was essential in demonstrating: 1) the ineffectiveness of the contractors exclusive chemical approach, and 2) the effectiveness of the IPM approach.

Simple tactics which are often overlooked can be effective pest management tactics. Geotextiles used to exclude weeds from planting beds minimize the need for herbicides. Physical removal of tent caterpillars which infest the flowering cherries of the Tidal Basin is just as effective as pesticide treatments (Fig. 4).

Spot treatment is an important IPM concept. When pesticides are applied, as in the case of carbaryl for Japanese beetle management on the cherry trees, the pesticide is only applied to heavily infested trees rather than to the entire planting. By minimizing the amount of pesticide applied to the chery trees, we hope to encourage scale parasites, such as the parasitic wasp, *Encarsia berlesei,* which is already present.

Timing is a critical aspect of many IPM tactics, particularly pesticide applications. For example, B.t., *Bacillus thuringiensis,* is used in some parks for gypsy moth management. This biological pesticide does not harm parasites and predators and is very effective if applied early in an infestation. However, treatment must be timed to occur after leaves are expanded and the larvae are in the 2nd and 3rd instar. Only by coordinating treatment with frequent and careful monitoring can a manager expect to achieve good results with B.t.

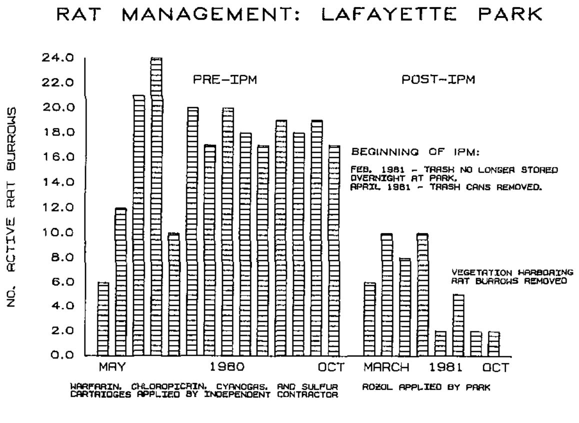

Fig. 3. Number of active rat burrows in Lafayette Park before and after the implementation of an IPM strategy.

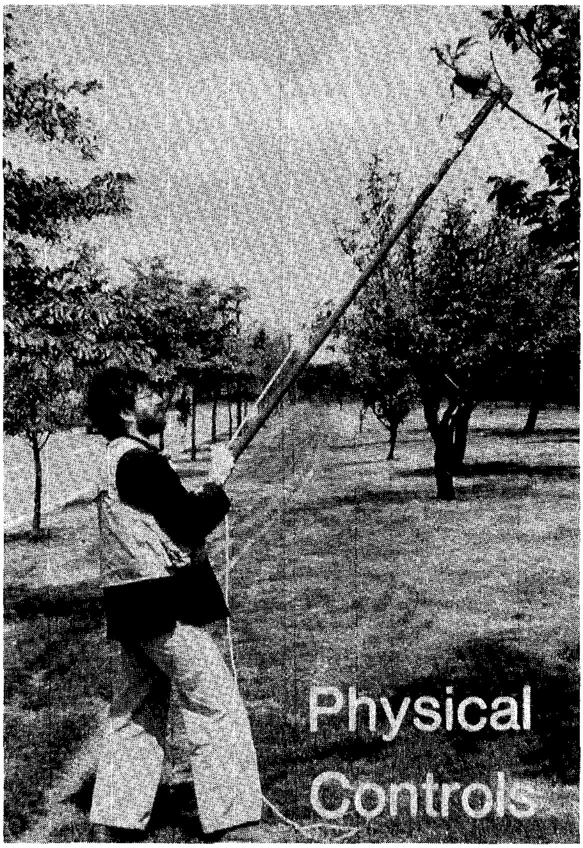

Fig. 4. Removal of tent caterpillar nests from cherry trees.

The timing of other management practices can also be critical in developing pest management strategies. Pruning cuts on American elm, for example, are highly attractive to the elm bark beetle *Scolytus multistriatus,* the vector of the Dutch elm disease pathogen. Consequently, we confine pruning to the inactive beetle period from late October to mid-April to minimize the number of crown infections.

Pesticides can be an important tactic in many IPM strategies. NPS pesticide policy, however, restricts the use of pesticides to those situations where alternative tactics alone are neither available nor acceptable. The restrictiveness of the NPS policy directs managers into the IPM decision-making process by prohibiting an early concession to the conventional chemical approach and requiring consideration of other tactics that could be used as alternatives to pesticides or in conjunction with them.

Action. In conventional chemical control, action usually involves calendar or "emergency" treatment of a suspected pest problem. As described, the IPM approach avoids routine or "knee-jerk" responses by requiring information, inspection and monitoring, and the development of an action plan before action is taken.

Evaluation. So often, strategies are applied with little or no follow up. Did the strategy work, did it fail, what were the secondary consequences? All management programs should have an evaluation component or "after action report". IPM requires a constant review not just of the tactics involved, but of the results achieved. The evaluation is made by reviewing the monitoring data. Adjustments can then be made by reviewing the monitoring data. Adjustments can then be made in the tactics and action levels. Weed monitoring in the turf (Fig. 5) of the J.F.K. Hockey Field on the Mall showed a weed cover reduction from 49 to 13% following a strategy involving herbicides, aeration, reseeding, and fertilization. Monitoring not only demonstrated an infestation well beyond aesthetic acceptability, but also demonstrated the efficacy of the renovation program.

Prevention through design and redesign. Most pest management is directed at pest problems that develop in existing landscapes. It is unfortunate that many of these problems are the result of inappropriate plant selection and improper design. Once these mistakes transcend the blueprint and become a living reality, the pests become a routine management chore. The aesthetic quality of a disease-susceptible crabapple planting, for example, can only be sustained with routine fungicide treatments. Once installed, the commitment to spray has been made for the life of the planting. Selection of resistant varieties would eliminate the necessity for treatment. The siting of plant material can also have an impact on pest management. We have found that azaleas planted in the shade are less prone to azalea lacebug infestations than those in full sun. Similarly, native dogwoods planted as isolated specimens, rather than in mulched clumps, are more prone to lawn mower injury and ultimately to infestation by the dogwood borer, which lays eggs in the mower wounds.

The most significant IPM tactic that can be applied in landscape IPM is *pest prevention through design and redesign.* Many pest problems can be circumvented by alternative plant choices and subtle design changes which provide for optimum plant health. This tactic can be applied most effectively by integrating pest managers into planning and design. Many landscape architects are not familiar with the pest problems that they are designing into the landscape and welcome review by professionals who can help avert problems that will lead to failure or costly maintenance. NCR has a Horticultural Advisory and Review Committee that combines the technical expertise of pest management specialists with that of landscape architects, arborists, agronomists and park managers in the review of landscape plans.

Pesticide Use

Like the pest and other related factors, pesticides should also be monitored. In initiating an IPM program in a large management system such as NCR, an analysis of the pesticide use will

Fig. 5. A one meter square monitoring grid is used to measure weed cover in turf.

indicate where the major problems are and where attention should be directed. Yearly monitoring of pesticide use can indicate trends in the pest management program. Accurate reporting by applicators and the use of microcomputers can assure a rapid and accurate portrayal of pesticide use throughout the management area.

IPM programs are commonly measured by the impact they have on pesticide use. The amount of pesticide active ingredient used in NCR from 1979 to 1985 is illustrated in Fig. 6. The 1979 data represents use prior to IPM. Since pesticide use reporting was not as accurate and complete prior to the IPM program, the amount reported for 1979 is conservatively low. In the last five years, pesticide use has remained constant, averaging 4700 pounds of active ingredient per year. This is 70% less than the amount used in 1979. Barring major increases in the park resources, it is likely that the use pattern will remain the same.

In reviewing pesticide projects during the transition to IPM, it was evident that there were projects that were not necessary, but had simply become part of the traditional maintenance regime. Much of the decline in our pesticide use simply resulted from the reduction or elimination of various pesticide projects which had little or no value. For example, NCR annually applied fungicide to hundreds of hollies to control leaf spot. The low disease incidence, however, did not warrant treatment. Similarly, European elms flanking the Reflecting Pool were sprayed for the elm case bearer. The insect is no longer treated. Although the pest is still present, the damage caused is hardly noticeable. Methoxychlor, once used extensively for both elm bark beetles and elm leaf beetles has been practically eliminated. Leaf beetle damage is minimal and considered aesthetically acceptable. Elm bark beetles are mangaged most effectively with thorough sanitation. A city-wide elm management plan provides an IPM approach for Dutch elm disease and places emphasis on sanitation in cultivated and natural elm stands (3). It provides for the deletion of methoxychlor when the disease incidence reaches 1% in the Monumental Core of the park system.

The examples demonstrate the need for annual project evaluation. Yearly review of pesticide use requests, as required by the NPS pesticide use policy, prohibits the institution of unnecessary programs as well as the continuation of programs beyond the time when they are no longer necessary or appropriate. No pest management program should become routine.

Summary

It is tempting to focus on pesticide reduction as the sole objective in IPM and therefore the only measure of success. However, in doing so, we sell IPM short by not appreciating other more significant advantages of the IPM approach.

The close assessment of the site-pest complex required in the IPM approach requires that managers look beyond the pest and consider the total complex and all of the factors, direct and indirect, affecting the problem. In doing so, we often realize that the pest is no more than a warning or symptom of a larger problem or imbalance in the resource or the way it is being managed. If a manager focuses on the larger problem, changes that have a more lasting effect on the pest are likely to be made than would be achieved through routine chemical treatment of the symptoms.

IPM enhances management credibility both within the organization as well as within the community. The IPM decision-making process removes the uncertainty from pest management and places the manager in a better position to justify and support pest management strategies, including strategies that require the use of pesticides.

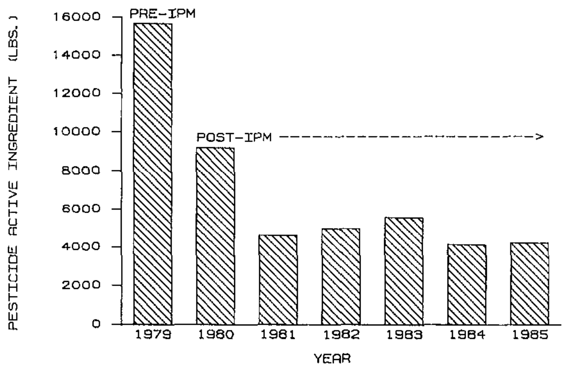

Fig. 6. Pounds of pesticide active ingredient used in the National Capital Region, National Park Service from 1979 (pre IPM) to 1985.

Literature Cited

1. Olkowski, William and Helga Olkowski. 1983. Integrated Pest Management for Park Managers; A Training Manual. National Park Service. pp. 90.
2. Redmond, Judith. 1984. *IPM for rats: A case history.* The IPM Practitioner, 6:2-3.
3. Management Program for the Perpetuation of the American Elm Tree in the Nation's Capital. Save-the-Elms Task Force. National Capital Planning Commission. December, 1983. pp17.

Plant Pathologist/Regional IPM Coordinator
and
IPM Assistant

Center for Urban Ecology
National Capital Region
National Park Service
Washington, D.C. 20242

Abstracts

INGRAM, DEWAYNE L. and WILL BURBAGE. 1986. **Transplanting trees in risky situations -- do anti-transpirants and additives help?** Am. Nurseryman 164(3): 81-82,84-85.

To reduce water loss during the establishment of transplanted trees and shrubs, some tree experts have suggested the use of anti-transpirants and soil additives. Anti-transpirants reduce water loss from leaf surfaces in two ways: coating leaves with impermeable films or inducing stomatal closures through bio-chemical mechanisms. However, the effectiveness of anti-transpirants on landscape plants has received mixed reviews from researchers and nursery operators. Researchers have concluded that careful digging and frequent watering during dry seasons were more important than applying Wilt-Pruf before digging or shading at planting. They report that Wilt-Pruf decreases the water loss and net photosynthesis of *Fraxinus americana* and *Pinus resinosa* for eight days but not thereafter. Another way to reduce transpiration is to use soil additives, such as Terra-Sorb. In one experiment, researchers found that the treatment did not influence their survival or growth, but installation costs increased by 27 to 30 percent. David Hensley, now at Kansas State University, Manhattan, found that Terra-Sorb increased plant survival by 286 percent (unpublished data).

WICK, ROBERT L. 1986. **Dieback and decline: principles of diagnosing their causes.** Am. Nurseryman 164(3): 87-88, 90.

With this article, I will not attempt to show how to diagnose specific causes of dieback and decline: rather my intention is to show the principles of diagnosing them. The terms dieback and decline are often used interchangeably to describe the death of twigs and branches of a tree or shrub. Other symptoms of poor health, such as small leaves, short annual growth and poor coloration, are usually associated with dieback. The term decline implies that the condition progressively worsens. Limb death or an overall decline in health is often the result of an impaired root system. Most of the time, diseases are not the result of a simple cause-and-effect relationship. Be sure to consider the following points: *Interview the client and gather pertinent case history information. Note clues that