INTEGRATED PEST MANAGEMENT — WHAT'S IT ALL ABOUT?[1]

by Ann F. Rhoads

Abstract. Current interest in Integrated Pest Management (IPM) has resulted from problems connected with over dependence on synthetic chemical pesticides. IPM draws on a variety of control methods to prevent pests from exceeding threshold levels. Success of IPM with agricultural crops is now being extended into the area of shade trees and woody ornamentals.

Integrated Pest Management (IPM) is an approach to dealing with pest problems within an ecological framework and with techniques that have been fully evaluated in terms of their economic and sociological impact. Key elements in an IPM program are information gathering and informed decision making.

Emphasis must be placed on the term *management*. Pest management implies efforts to prevent pest populations from becoming a problem by preventing them from reaching levels at which economic or aesthetic damage will result. *Threshold* is used to describe a level of pest presence above which unacceptable amounts of injury are likely to occur. The implication contained within the threshold concept is that sub-threshold pest populations can be tolerated. A related concept is the *action level*, the point at which control measures are necessary to prevent a pest population from exceeding the threshold. Clearly, the determination of thresholds and action levels for the management of pests requires detailed knowledge of each pest's life cycle, seasonal development and population dynamics. An ongoing monitoring effort is essential to provide data on plant status, pest presence and other relevant environmental factors.

The need for information, however, extends beyond knowledge of host and pest biology and ecology. Once a need for control has been established a wide range of strategies and mechanisms must be evaluated. An IPM program places emphasis on controls which are least disruptive to the ecosystem as a whole. Whenever possible, long-range solutions that minimize susceptibility to pest problems are sought. Plant selection, habitat modification and cultural practices that favor host vigor and decrease susceptibility to pests are encouraged as are practices that make it possible for natural biological controls to function effectively. When chemical controls are needed, the use of highly specific, carefully timed and localized treatments is preferred over the traditional cover spray approach.

Why Has IPM Become So Appealing Today?

To answer this question we must go back to the early 1940's to the advent of synthetic organic pesticides. DDT was, at that time, hailed as the miracle substance that would eliminate insect pests once and for all.

DDT's qualities included long persistence, broad spectrum activity and effectiveness in small quantities. Its success led to widespread use and exclusive reliance on chemical pest control. Soon, whole families of synthetic pesticides came into being. The chlorinated hydrocarbons, of which DDT was one, were joined by the organophosphates, dithiocarbamates, thiazoles, and others. However, the very qualities that made DDT and others so useful soon led to problems.

As early as 1946, populations of houseflies resistant to DDT had been identified. By 1966, 224 species of insects and/or mites had developed resistance to one or more pesticides (4). Fungal and bacterial pathogens have been equally successful in overcoming pesticide toxicity (3). Resistance to the systemic fungicide benomyl has been reported in many common phytopathogenic fungi including the causal agents of apple scab, powdery mildew, brown rot and

1. Presented at the annual conference of the International Society of Arboriculture in Milwaukee in August of 1985.

Cercospora leaf spot. The short reproductive cycles of many insects and microorganisms mean that resistant individuals can quickly become dominant in a population subjected to frequent pesticide exposure. Efforts to totally eradicate certain pest species resulted in even greater selective pressure favoring the development of resistant forms.

The immediate response to the problem of resistance was to increase application rates and to develop new, more potent pesticide formulations. An enormous proliferation of products took place.

Another problem associated with widespread pesticide use is the unforeseen effects on the environment of pesticide residues. The negative impact on birds of prey has been well documented. Predators are particularly susceptible to the concentrating effect that occurs as residues move through the food chain. In 1962, Rachel Carson, in her book *Silent Spring*, focused the attention of the world on the threat posed by DDT (1). Residues had by then been found in Antarctic birds and seals remote from any area where the chemical had been used. Today we are still discovering some of the dangers of long-term pesticide exposure.

The related phenomena of release and resurgence have also dampened the enthusiasm for continued reliance on chemical pesticides. Release refers to the generation of secondary pest outbreaks due to pesticide induced disruption of beneficial insects which otherwise serve as natural biological controls. Predatory mites that prey on plant feeding mites and tiny, host specific parasitic wasps that attack aphids, caterpillars and other plant pests have been particularly vulnerable to damage due to widespread use of broad spectrum insecticides.

Resurgence refers to the tendency of pest populations to recover faster than their parasites or predators after spraying. This phenomenon has been demonstrated in the case of Fiorinia scale on hemlock where scale populations on sprayed trees had greater fecundity and a more rapid rate of development than did those on unsprayed controls. One parasite and three predator insects were virtually eliminated from sprayed trees (7).

These problems, plus concern for the direct impact of pesticide use on public health and safety have led many to seek an alternative in IPM.

Components of An IPM Program

Monitoring is an essential part of all IPM programs. There is no substitute for getting out and looking at the plants to keep abreast of pest presence, plant condition, and natural control potential. An IPM scout must be knowledgeable regarding pests and their various life stages and able to recognize beneficial insects also. Plantings should be sampled frequently enough to detect changes in pest levels. Monitoring should not cease if and when control measures are taken as a follow up evaluation of the effectiveness is important.

Table 1. Control tactics available to the integrated pest manager.

Avoidance
Design and plant selection
Resistant Plants
High Species Diversity
Elimination of alternate hosts
Garden sanitation
Cultural practices
Timing of fertilization, watering, etc.
Site preparation
Crop rotation
Physical/mechanical
Hand removal of pests or diseased plant parts
Correct pruning and wound care
Mechanical barriers
Biological controls
Parasites and Predators
Naturally occurring
Introduced
Microbial products
Bacillus thuringiensis
Milky spore disease
virus preparations
Life cycle disruption
Pheromones
Juvenile hormones
Release of sterile male insects
Traps and baits
Pheromone traps
Yellow sticky board traps
Chemical sprays
Horticultural oils
Insecticidal soaps
Synthetic chemical pesticides

Written records of all observations are essential as data gathered by IPM scouts are the bases for decision making regarding the need for control measures. Pest populations must be evaluated to determine if thresholds are being reached. Thresholds have been established for many pests of agricultural plants where crop yield in response to pest activity is readily measured. The establishment of thresholds for damage to ornamental plants has been slower as the issue involved is one of aesthetics rather than one that can be measured in pounds or bushels.

Once pest populations reach a level at which action is needed a decision must be made as to the most appropriate means of control. General goals are a high degree of specificity with a minimum impact on other components of the environment. Control measures include biological means such as encouraging or introducing beneficial insects which act as parasites or predators, the use of microbials including Bt (*Bacillus thuringiensis*) or milky spore disease, release of sterile male insects or life cycle disruption through the use of pheromones or juvenile hormones. The use of traps, baits, and physical barriers is another possibility. Hand removal of some types of pests may be the best choice in some cases. Oil sprays, both dormant and growing season applications, and insecticidal soaps are proving very useful to control pest insects with minimal effect on beneficial species (6). Chemical pesticides also have a place in an IPM program. Timing, specificity and the use of spot treatments is encouraged. With limited use, pesticides will pose less of a threat to the environment and retain their effectiveness longer.

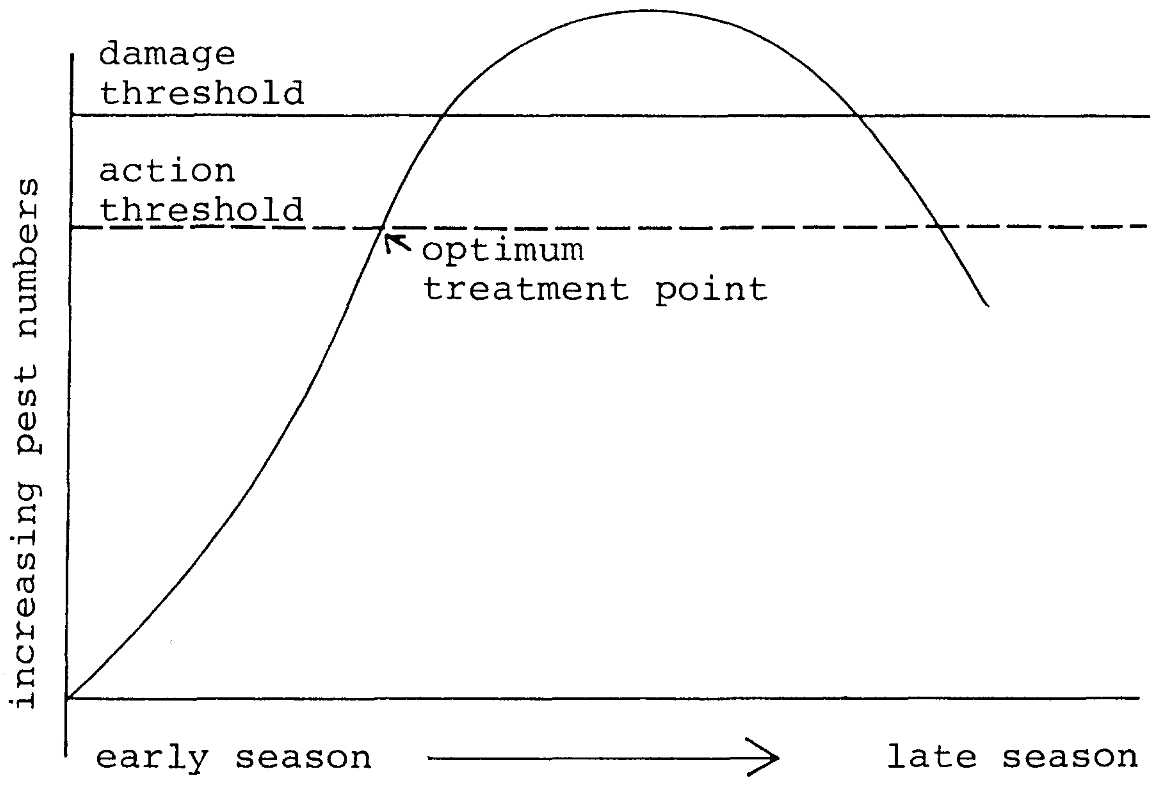

Figure 1. Pest population curve showing damage threshold and action threshold. Adapted from Olkowski and Olkowski (8).

IPM is Working

The greatest strides in developing IPM has been in the area of agricultural crops such as cotton, citrus, apples, or alfalfa where successful programs have been in operation for ten years or more (4). Pest control costs are down with no loss of yield or quality. The application of this technology to ornamental plantings has been more recent. Researchers at the John Muir Institute in Berkeley and the University of Maryland have led the way in developing IPM programs for shade trees and ornamentals. The National Park Service implemented an IPM program developed by the John Muir Institute which resulted in a 70% reduction in pesticide use between 1979 and 1983 (2, 8). A 1982 University of Maryland study involving 26 suburban home landscapes resulted in a 94% reduction in pesticide use compared with the standard three cover spray approaches formerly utilized (5). The IPM services in this project involved private arborist firms and resulted in a high degree of customer satisfaction.

Innovative landscape maintenance firms are responding to public concern over pesticide use by offering an IPM option and finding it makes good business sense.

Literature Cited

1. Carson, R. 1962. Silent Spring. Houghton Mifflin, Boston.
2. Daar, Sheila. 1985. *New achievements in National Park Service IPM program.* IPM Practitioner 7:6.
3. Dekker, J. 1976. *Acquired resistance to fungicides.* Ann. Rev. of Phytopath 14:405-428.
4. Flint, Mary Louise and van den Bosch, Robert. 1981. Introduction to Integrated Pest Management. Plenum Press, NY.
5. Holmes, John J. and Davidson, John A. 1984. *Integrated pest management for arborists: implementation of a pilot program.* J. Arboric. 10:65-70.
6. Johnson, Warren T. 1982. *Horticultural spray oils for tree pest control.* Weeds, Trees and Turf, May 1982.
7. McClure, Mark S. 1977. *Resurgence of the scale fiorinia externa (Homoptera: Diaspididae) on hemlock following insecticide application.* Environ. Entomol. 6:480-484.
8. Olkowski, Wm. and Olkowski, H. 1983. Integrated Pest Management for Park Managers — A Training Manual. John Muir Institute, Inc., Napa, CA.

Assistant Director of Botany
Morris Arboretum
Philadelphia, Pennsylvania 19118

ABSTRACT

CLINE, MOLLY N. 1985 **Stopping fire blight requires knowing its symptoms and acting promptly.** Am. Nurseryman 161(11): 83-88, 93-95.

Fire blight is a very serious and damaging disease caused by the bacterium *Erwinia amylovora.* The most seriously affected species are the cultivated apple, pear, and quince. Any portion of a susceptible plant can be attacked by fire blight bacteria. Blossom blight, shoot blight, and branch and trunk canker are the most common types of symptoms induced by the fire blight organism. The fire blight bacterium overwinters in living tissue at the margins of trunk and branch cankers and sometimes in buds. In spring, when temperatures are above 65°, the bacteria resume activity and rapidly multiply. They are pushed to the surface of the canker, where they form bacterial droplets and strands of ooze. The bacteria infect the nectaries of blossoms and multiply. Actively growing shoot tips are infected by bacteria that have been spread by rain or insects from both cankers and infected blossoms. The following practices should be followed for the proper control of fire blight: choose the proper cultivars, cultural practices, remove fire blight cankers, and follow a spray program.