INTEGRATED PEST MANAGEMENT
MU Guide
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Integrated Pest Management in Missouri's Urban Environments

Department of Plant Sciences

Missouri's urban environments include not only the diverse physical areas associated with its cities, small towns and neighborhoods but also the environments inside its businesses, houses, schools and hospitals. Missouri has more than 4,200 cities and towns ranging from the metropolitan urban areas of St. Louis and Kansas City; to the medium-sized cities of Joplin, Springfield, Columbia and Kirksville; to small towns such as West Plains, Bolivar and Hartsburg scattered throughout the state.

Missouri's urban environment is conducive to the development of both indoor and outdoor pests. In the past, reliance on pesticides for pest management has resulted in pesticide resistance and the development of stronger pesticides. The increased use of pesticides has also resulted in greater potential for human and pet exposure. Missouri's citizens are increasingly concerned about pesticides and excess nutrients polluting their surface and groundwater sources and pesticides' effects on human health, nontarget organisms and food safety as well as pesticide waste.

Integrated pest management (IPM) stresses routine inspection and monitoring and reserving treatment with pesticides for only those times when pests are present. IPM does not operate on the policy of routine applications based on calendar dates whether or not pests are present. When pesticides are necessary, IPM seeks to use those that are the least toxic and most environmentally friendly.

The importance of IPM

IPM in the urban environment has a somewhat different focus than its applications in the agricultural environment. Like agricultural IPM, it can be thought of as a systematic approach to solving pest problems by applying our knowledge about pests to prevent them from reaching unacceptable levels. Unlike agricultural IPM methodology, urban IPM is not based solely on economic threshold models that justify treatment only when pest populations or pest damage has exceeded this threshold. IPM in the urban environment places human health and the social, environmental and aesthetic concerns of the community at the forefront of its primary focus.

One such example is the use of pesticides in sensitive areas such as hospitals and food service establishments. Because the use and/or presence of pesticides can create real or perceived risks, decisions about their use need to take into account cultural, biological, genetic, regulatory, physical and chemical effects in determining pest management solutions.

IPM: A short history

During the 1960s, a new awareness of ecology and the environmental impact of pesticides and pollution resulted from a public outcry about environmental contamination found in the air and foul water found in rivers and streams. Before then, the adage of "if a little works, a lot will work better" was the major premise for applying chemicals to address pest problems on the farm and around the home. As a result of this public outcry, in 1972 the U.S. Department of Agriculture made funding available to develop an IPM network through the Agriculture Extension Service.

In the early 1970s, the Environmental Protection Agency and Congress enacted a "new" pesticide law, the Federal Insecticide, Fungicide, Rodenticide Act (FIFRA), a driving force in the establishment of a national program for the certification of pesticide applicators. The primary focus of this new law was to provide federal control of pesticide distribution, sales and use. Under FIFRA, the EPA was given authority not only to study the consequences of pesticide use but also to require users to register when purchasing restricted-use pesticides. One of the first goals of this program was to provide the quantity and quality of information needed for people using pesticides, ranging from structural pest control specialists to farm laborers.

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IPM program goals

The University of Missouri's IPM program has been in place since the mid-1970s. Although IPM programs originally focused mainly on insect control, today's programs consider all categories of pests including weeds, diseases and vertebrates.

At the national level there are four objectives that characterize the IPM program:

1. Safeguard human health and the environment through improved application of IPM strategies and systems.
2. Increase the range of benefits to enterprises and individuals through improved use of IPM strategies and systems.
3. Increase the supply and dissemination of information and knowledge about IPM strategies and systems.
4. Enhance collaboration between public, private and nonprofit stakeholders to foster improved use of IPM strategies and systems.

MU's IPM program has specific objectives related to urban interests:

1. Train and provide support for regional extension specialists to serve clientele on the local level.
2. Provide training for homeowners, professional pesticide applicators, consultants and other IPM professionals in the private sector.
3. Develop educational materials to aid in the pest management decision-making process for pests relevant to Missouri's landscapes and structural settings.
4. Monitor and document changes in pest management practices.

By working to implement these objectives, the University of Missouri plays a vital role in helping to minimize the negative effects misused pesticides can have on our urban environment.

Steps of effective IPM

A successful urban IPM program is contingent on developing a comprehensive plan. Building a plan around the following six steps will help ensure success:

1. Establish a policy.
2. Identify pests correctly.
3. Monitor pest populations on a regular basis.
4. Determine action threshold.
5. Choose the proper management tactic or combination of tactics.
6. Evaluate the effectiveness of the management plan.

Establish a policy

There are specific local, state and federal guidelines mandating policy for pest management. There are also laws that protect us from the unauthorized use or misuse of pesticide products in a manner inconsistent with their labeling. A clearly defined comprehensive pest management policy must meet all regulatory laws and guidelines.

Pest management providers need to establish a clearly defined comprehensive policy regarding pest management practices and procedures. Clientele need to be informed of what IPM is and how it differs from non-IPM, calendar-based pesticide applications. A comprehensive policy needs to communicate clearly the benefits that IPM can deliver, and it needs to provide details of how pesticides will be selected, applied and stored. The plan needs to include information about who will be involved in the application process and what the expectations are for them. Outline client notification procedures in the event that special precautions may be necessary before pesticides are applied. For an effective IPM program to succeed, building occupants need to know they play a major role in making sure sanitation measures are given high priority in order to reduce the risk of future infestations.

Identify pests correctly

Because not all insects are harmful pests, it is vitally important to properly identify pests before taking action. Only a small percentage of insects are considered harmful. Some insects are natural predators or parasites that actually help to control pest species. Proper identification, and in some cases knowing a pest's life stage, is also important to determine before applying a pesticide. The proper selection of a pesticide is dependent upon the correct identification of the pest.

Monitor for pest outbreaks

IPM encourages the method of scouting to detect pests and determine if action is necessary. If damage can be detected before a serious pest population becomes established, several problems can be prevented. Implementing several practical considerations can save time in a scouting program.

When making an initial IPM-based inspection, keep in mind that the scouting process can take more time to complete than subsequent calendar-based treatments. Knowledge of pest behavior, anatomy and life cycle are of utmost importance to a successful IPM program. Some insect pests are present only during specific times of the year. Anticipating the life cycle and time of pest development can alert pest managers to the most opportune times for scouting. Knowing a pest's habitat can save time in the monitoring program. For example, moist areas, such as underneath sinks, tend to attract some insect pests. Such areas should be watched more frequently and closely. With a little experience, pest managers can predict when the pest will appear and what damage will occur.

When considering a plan of action, remember that environmentally friendly management measures, such

as vacuuming with equipment specifically designed for pest removal or trapping, may be an effective alternative. Before applying pesticides, consider applying lower than maximum registered rates and spot treatments where possible. Keeping records that contain monitoring counts, sanitation practices, pesticide use and other relevant information can be helpful in the development of long-range IPM programs.

Establish urban IPM action thresholds

Although the original IPM models developed for agricultural environments were based on economic thresholds, the urban IPM model focuses on two types of thresholds that must be considered when making pest management decisions. First, the amount of damage that a homeowner or other tenant can tolerate is referred to as the "aesthetic threshold." Second, the "injury threshold" refers to the level of damage a plant can tolerate. In some instances, pest acceptance levels may be greater because of social or cultural factors or because of concerns about the costs or hazards of pest management methods used.

With injury thresholds, damage levels associated with specific pest densities are more readily known, and treatment tends to be more precise. For example, summer infestations of aphids do not always cause damage to roses. However, because aesthetic value is often a primary concern in landscape settings, individual tolerance levels can vary. A pest acceptance level can be extremely low in high-visibility or high-use sites. For example, managers of interior landscapes within a shopping mall will desire blemish-free plants. Landscape managers may be willing to tolerate different levels of pests in different situations and make site-specific management decisions. If spring aphid infestations are controlled, then summer infestations are usually not severe.

In addition, there may be health and safety threats or legal concerns associated with certain pests. In this case, thresholds are more clearly defined. One mouse or cockroach in a school cafeteria kitchen may not be considered either an "aesthetic" or an "injury" level threshold, but it may be sufficient to initiate control measures for health reasons.

IPM control tactics in the urban setting

A variety of integrated pest management strategies have been proven effective for use in urban arenas:

- *Biological* — The use of beneficial organisms can help suppress pest development. They may include natural pest predators, parasites and even some diseases targeted at specific pest populations. These can include natural enemies, such as lady beetles, lacewings and beneficial wasps that provide control of insect pests when incorporated with a variety of plants in a landscape. In addition, *Bacillus thuringiensis* is a bacteria that produces a protein that is toxic to many species of insects including cabbage loopers, leaf rollers, fungus gnat larvae and mosquito larvae. There are also biological nematicides on the market for control of soil-inhabiting plant parasitic nematodes in turfgrass. Some natural control products containing pyrethrins are also available for use both indoors and outdoors because of their relative safety. Such products are used as industrial sanitation sprays to protect stored food in warehouses.
- *Cultural* — Proper sanitation is the first line of defense against household and structural pests. Cleanliness and elimination of favorable breeding sites will greatly reduce the possibility of infestation for a wide variety of insect pests and help control the spread of disease.
- *Physical* — Using physical barriers or traps and altering pest habitat can help diminish pest pressure. Some ant and roach traps contain no pesticides at all but lure pests by way of a food-attractant onto an adhesive. Some traps rely on pheromones and other scents to attract insects such as Japanese beetle traps. Caution needs to be taken in placing these traps in the landscape because they can often attract more pests into an area than they catch in the trap. Window screens and caulking are examples of commonly used physical barriers that are inexpensive and readily available. The alteration of pest habitat has also been used in mosquito control programs by draining water from their breeding sites.
- *Genetic* — Choosing landscape plant cultivars with built-in resistance can reduce pest problems and help control the spread of disease.
- *Chemical* —The use of chemical pesticides is often needed even when other, non-chemical practices are followed. If pesticides have to be used to prevent or suppress a pest outbreak, it is important to use one that's as specific to the pest as possible. Consider using a pesticide at its lowest effective rate that's short-lived in the environment and is least toxic to beneficial organisms and the environment. When possible, alternate pesticides with unique chemical modes of action to help prevent resistance. In structural situations where immediate control is necessary, pesticides are often the first choice of action.

Evaluation

Evaluation of treatment results is crucial in determining if your pest management program is working. A successful IPM program needs to answer the questions of what worked, what didn't work and what requires revision, improvement or elimination. Evaluating your IPM program will help you determine not only the social and environmental benefits of your actions but the financial benefits as well.

Pest problems on the horizon for Missouri's urban environment

Japanese beetle

The Japanese beetle (*Popillia japonica*) was first found in the United States in 1916, following accidental introduction from its native country of Japan. It is now common to the eastern United States and for the past 70 years has been in pockets of Missouri such as Springfield, Sedalia and western Missouri. These pockets have been expanding during the last few years and populations have been increasing.

Japanese beetles are ½-inch long and metallic green in color with bronze or copper-colored wing covers. They can often be confused with the green June beetle but are smaller. Japanese beetle adults often congregate in large numbers to feed on foliage and fruit of 300 to 400 different hosts, including fruit and ornamental trees and shrubs, as well as agricultural plants such as corn and soybean plants. Typical feeding damage by the beetles is often seen as a lace-like pattern on the foliage of host plants as beetles avoid leaf veins when feeding. Japanese beetles often begin feeding at the top of plants and move downward.

Adult beetles emerge from the soil in May and June to feed for about 60 days. During this time the beetles mate and females deposit eggs in the soil. Each female may lay 40 to 60 eggs, and larvae emerge after a period of roughly two weeks. Larvae will feed on plant roots and decaying material before overwintering in the soil as third instars. The following spring, larvae quickly finish development, pupate and emerge as adult beetles beginning in May.

Emerald ash borer

On July 23, 2008, USDA scientists discovered seven emerald ash borer beetles (*Agrilus planipennis*) in traps in Wayne County at a campground located at the U.S. Army Corps of Engineers' Greenville Recreation Area near Wappapello Lake in southeast Missouri.

The emerald ash borer is an aggressive wood-boring insect that attacks and kills all species of ash (*Fraxinus*) trees. Attacks by this metallic-colored beetle of the *Buprestidae* family usually kill ash trees in one to three years. Although stressed trees are usually more prone to borer attack than healthy trees, evidence from Michigan suggests that even healthy, well-maintained ash trees are being attacked and killed by this beetle.

The natural range of the emerald ash borer is eastern Russia, northern China, Japan and Korea. It was first discovered in North America in Michigan in June 2002. The borer most likely traveled from Asia to North America in wooden packing materials. Because adult insects only move short distances on their own, the continuing spread of this beetle is primarily by human transport of ash wood products. To combat the further spread of the emerald ash borer, officials are urging people to obtain firewood locally and not transport firewood to or from campgrounds.

The emerald ash borer's arrival in Missouri was unwanted but not unexpected. Although the emerald ash borer has only recently been found in Missouri, it has been found in isolated infestations in the neighboring state of Illinois. Currently, there are 21 counties under quarantine in Michigan and isolated infestations in Ohio, Indiana and Maryland as well as Ontario, Canada.

A new Web site for emerald ash borer information has recently been created. The *eab.missouri.edu* site is a one-stop shop for the latest news, developments and strategies for managing emerald ash borer in Missouri. For current national information on emerald ash borer, visit *emeraldashborer.info.*

Gypsy moth monitoring and detection in Missouri

The gypsy moth (*Lymantria dispar*) is an exotic and destructive pest that threatens the health of Missouri's forests and urban landscapes. Each gypsy moth caterpillar can consume up to 11 square feet of hardwood foliage from May until June. When abundant, caterpillars can completely defoliate trees. They are also a public nuisance in recreational and residential areas because of the excrement that falls from trees and coats foliage and grass.

Gypsy moths are slowly expanding their range toward Missouri, spreading by wind and by people unknowingly carrying moths on vehicles, nursery stock or other outdoor items. Although there are no infestations currently in Missouri, an annual multiagency effort to detect introductions from other infested regions is conducted by using pheromone lures in sticky traps. If actively reproducing gypsy moth populations are detected, programs using IPM techniques will be used to stop their spread.

The cooperating agencies for the Missouri Gypsy Moth Survey are the Missouri Department of Agriculture, Missouri Department of Conservation, the Plant Protection and Quarantine wing of the USDA Animal and Plant Health Inspection Service and the University of Missouri IPM Program.

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■ Issued in furtherance of the Cooperative Extension Work Acts of May 8 and June 30, 1914, in cooperation with the United States Department of Agriculture. Director, Cooperative Extension, University of Missouri, Columbia, MO 65211
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