CONTINUING EDUCATION UNIT

Integrated Pest Management Tactics

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This is the second of two articles on integrated pest management (IPM) in urban landscapes. The first article in this series identified the major types of landscape pests, defined IPM, and described the relationship between IPM and Plant Health Care (PHC). The article also explained fundamental IPM concepts and procedures, including action thresholds and monitoring techniques. This final installment describes both pest preventive and control tactics that arborists can use to effectively manage landscape pests in a profitable, environmentally responsible manner. Although IPM strategies are often pest specific, the following tactics are applicable to most landscape scenarios.

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LEARNING OBJECTIVES

The arborist will be able to

- identify the main goals of pest preventive tactics
- describe the considerations that should be made when selecting a pest control tactic
- identify the main pest control goals
- classify different control tactics into cultural, biological, and chemical
- discuss available pest management tactics and their trade-offs

Pest Preventive Tactics

As the name implies, preventive tactics are intended to prevent landscape pests from becoming problems that require intervention. While control tactics are often necessary for managing pests, prevention should be the main focus of every landscape IPM program. There are two basic goals for pest preventive tactics:

- Minimize plant stress by encouraging favorable plant development conditions.
- Minimize pest activity by discouraging favorable pest development conditions.

Plant stress is a reversible impairment of plant function resulting from a deficiency or excess of one or more survival factors (such as light, water, temperature, and nutrients). Both abiotic (nonliving) and biotic (living) agents cause plant stress. Abiotic stress agents can be either natural (such as drought, infertile soil, and storm damage) or man-made (such as misguided landscape management, injury, and contamination). Biotic stress agents include competition and allelopathy from neighboring plants and infestation by primary pests. Heavily stressed plants have limited energy resources for self-defense and thus are more susceptible to secondary pests.

The second goal in pest prevention is mitigating landscape conditions that promote pest activity. Many pests thrive under adverse site conditions (such as temperature, moisture, and light extremes) and misguided management practices (such as improper mulching, irrigation, and fertilization). Fortunately, cultural practices and plant selection are reliable tactics for reducing both plant stress and pest activity.

Cultural Practices

Within the PHC management system, cultural practices are incorporated into the IPM strategy to reduce plant stress and pest activity. Proper use of cultural practices such as mulching, irrigation, fertilization, and pruning enhances plant development (Figure 1). Prescribing appropriate cultural treatments requires knowledge of plant-specific needs and the ability to diagnose plant stress through observation and site assessment. IPM practitioners should also be able to recognize when plant stress has progressed to plant strain—a nonreversible condition resulting from excess stress. In such instances, cultural treatments are not effective and culling the strained plant is the most feasible remedy for the pest problem.

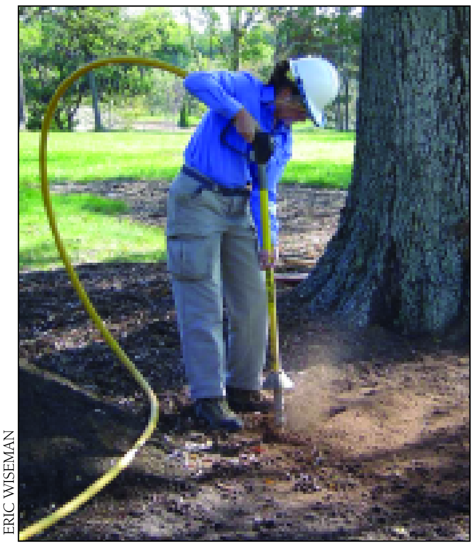

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Figure 1. Cultural practices such as soil management improve plant health and help prevent pest problems.

Landscape sanitation is also an important cultural practice for preventing pest problems. Excessive buildup of plant litter provides breeding, refuge, and overwintering sites for certain pests. While it is important to maintain a litter layer over the root zone, excessive litter should be collected and disposed of seasonally. Dead branches and fruit that remain on plants can also harbor pests and should be removed as well. To prevent the spread of pests, plant debris should be removed from the landscape and properly disposed by chipping, burning, composting, or land filling.

Improper use of cultural treatments and pesticides can encourage pest activity or increase plant susceptibility to pests. For example, pruning during early summer can increase susceptibility to oak wilt (*Ceratocystis fagacearum*), while overirrigation creates a favorable habitat for *Phytophthora* root rot. Use of broad-spectrum pesticides can decimate both insect pests and their natural enemies, which often leads to pest resurgence or a mite outbreak. Understanding the biology and behavior of key landscape pests helps prevent pest problems that arise from improper landscape management practices. It is also important to educate clients and other professionals who work around the landscape about basic PHC concepts. In particular, address common plant stress factors such as improper irrigation, improper mulching, soil compaction, mechanical injury, and misapplication of de-icing salts.

Plant Selection

IPM practitioners should always encourage clients to use pest-resistant plant species, high-quality nursery stock, and a diversity of plant species. Proper plant selection and placement are important to pest prevention and can considerably reduce the need for control tactics, particularly pesticide use. Certain plant taxa, such as the genus *Prunus,* have an inherently high incidence of pest problems and should be used cautiously in urban landscapes. Plant placement within the landscape also influences pest susceptibility (Figure 2). For example, boxwood (*Buxus* spp.) placed in poorly drained soils are more susceptible to *Phytophthora* root rot. Clients should be cautioned about the use of pest-prone plants on high-risk sites, especially when they have high expectations for plant performance or limited resources to invest in pest management.

BILL FOUNTAIN

Figure 2. Improper plant placement in the landscape can increase the incidence and severity of pest problems.

High-quality nursery stock is much more tolerant of transplant stress, which can predispose plants to secondary pests such as borers and canker fungi. The cultural needs of plants during establishment, especially irrigation, should be carefully monitored to reduce transplant stress and pest susceptibility. Choosing high-quality nursery stock also reduces the risk of introducing pests from the nursery to the landscape.

Plant species diversification may help minimize the incidence and severity of pest problems in the landscape. Overreliance on a few plant species can have catastrophic consequences for the landscape when an uncontrollable pest is introduced. A high density of a vulnerable plant species in the landscape may also favor insect dispersal and disease transmission. Not only can diversification decrease the likelihood of a landscape pest catastrophe, but it may also promote natural pest control by providing alternate food sources and refuge for the natural enemies of pests.

Pest Control Tactics

Preventive tactics are often insufficient for managing pest populations and plant injury at tolerable levels. When monitoring reveals that an action threshold has been exceeded, applied control tactics may be required. When selecting the pest control tactics for an IPM strategy, several considerations should be made:

- Identify the control goal for the pest.
- Identify all possible pest control tactics and consider the advantages and disadvantages of each.
- Whenever possible, choose pest control tactics that have the least detrimental impact on the landscape ecosystem.
- Integrate pest control tactics into a single pest management strategy for maximum efficiency and effectiveness.

IPM practitioners must choose from three pest control goals: prevention, eradication, and suppression. For some pests, prevention may be the only feasible control goal. For example, many weeds, fungal diseases, and insect pests are most effectively controlled with preventive pesticide applications. Many of these pests cannot be treated once they reach a certain developmental stage or infestation level.

Eradication is a rare goal in landscape IPM because it is usually unnecessary and often difficult to achieve. However, eradication may be necessary when dealing with highly noxious, introduced pests. In extreme examples, such as with emerald ash borer (*Agrilus planipennis*), plants that are infested by the pest must be destroyed as part of an eradication program. IPM practitioners should be aware of local or regional pest eradication programs and comply with them where applicable.

Suppression is the typical pest control goal in landscape IPM. The intent is to reduce the pest population

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and associated landscape damage to a tolerable level. Suppression is the preferred pest control approach because it usually can be achieved with limited applications of pesticides while still meeting the client's expectations for landscape performance. This approach is both cost effective and environmentally responsible.

In landscape IPM, control tactics are broadly classified into three groups: cultural control, biological control, and chemical control tactics. For many landscape pests, effective control tactics are available in all of these groups. There are always trade-offs among control tactics in terms of cost, feasibility, effectiveness, persistence, environmental impact, aesthetic impact, and social acceptability. The IPM practitioner should first discuss the available pest control tactics and their trade-offs with the client and then choose the most appropriate control tactic(s) based on the client's input and personal knowledge and experience.

Cultural Control

Cultural control tactics entail either physical manipulation of the landscape or using mechanical devices to alter pest activity, reproduction, or survival. Many of the cultural preventive tactics previously described are also used as cultural control tactics. The main distinction is that cultural control tactics are implemented for existing rather than anticipated pest problems. Cultural control tactics are very desirable because they usually have limited impact on nontarget organisms and the environment.

Improper mulching and irrigation can create favorable conditions for landscape pests. Correcting an improper mulch application (such as mulch heaping on trunks) removes favorable habitat for bark-feeding rodents and insects. Overirrigation often causes problems with root pathogens such as *Phytophthora*, while insufficient irrigation can leave plants vulnerable to wood-boring insects and mites. Simply altering irrigation practices is often sufficient to control these pest problems.

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Figure 3. Localized pest infestations such as these bagworm larvae can be controlled with pruning.

Pruning is an effective cultural control tactic for plant pests. Localized pest infestations on landscape plants can be controlled by removing and destroying infested portions of the plant (Figure 3). Crown cleaning of dead and dying branches removes breeding and feeding sites for certain pests. Crown thinning and raising improve air circulation and light penetration, which can decrease the severity of numerous fungal diseases. Thinning can also improve the efficacy of pesticide applications by permitting better spray penetration to the center of the canopy.

Sanitation and eradication are also important cultural control tactics. Sanitation entails the removal of dead or infested leaves, twigs, and fruits that accumulate in the plant or on the ground. This debris is an ideal refuge for pests such as black vine weevil (*Otiorhynchus sulcatus*) and rodents. Eradication is an extreme measure taken to control pests that are particularly noxious or for which there are no alternative control tactics. Eradication entails the complete removal of a pest population through extermination or destruction of infested plants. Pest eradication on a large geographical scale is a difficult task and typically is effective only at the landscape level by destroying infested plants.

Numerous mechanical devices are used to alter pest activity, reproduction, or survival. Landscape damage by vertebrate pests such as deer, rabbits, rodents, and birds can be discouraged by using barriers, repellents, and startling devices (noisemakers, flashers, and scarecrows). Where permissible by law, vertebrate pests can be controlled by lethal trapping or by live trapping and relocation.

Arthropod pests can also be controlled with mechanical traps. Clearwing moths (family: Sesiidae) can be controlled with pheromone-baited sticky traps placed strategically around the landscape. Cankerworms and related caterpillars (family: Geometridae) can be controlled by banding the trunk of susceptible trees with an adhesive that traps flightless female moths as they crawl up the trunk to mate and lay eggs in the crown. Insect pests can also be mechanically removed from host plants. Examples include picking bagworm larvae (*Thyridopteryx ephemeraeformis*) from infested canopies and extracting peachtree borer larvae (*Synanthedon* spp.) from infested trunks.

Biological Control

Biological control is a method for managing landscape pests using natural enemies—predators, parasites, and pathogens. IPM practitioners use both natural and applied biological control tactics. Most landscape pests have biological controls that naturally regulate their populations. In many instances, natural biological control maintains pest populations at tolerable levels, and applied controls are not necessary. Natural biological control can be disrupted by disturbances in the landscape ecosystem, including introduction of foreign pests and misuse of broad-spectrum pesticides. Organisms introduced from foreign regions often become landscape pests because their natural enemies are not present in their new environment. A classic example is hemlock woolly adelgid (*Adelges tsugae*). Broad-spectrum pesticides can decimate both insect pests and their natural enemies, which often leads to pest resurgence or a mite outbreak.

When natural biological control is insufficient to suppress pest populations, an applied biological control tactic may be warranted. Applied biological control is an attractive pest control option when working in sensitive environments or with sensitive clients. There are three approaches to applied biological control: introduction, conservation, and augmentation. The natural enemies of foreign pests are often introduced in an attempt to replicate the natural checks and balances found in the foreign pest's native habitat. Introduction is particularly valuable for pests that threaten native ecosystems and have few feasible control options.

Conservation of natural biological control is achieved through careful use of other control tactics (particularly pesticides) that may adversely affect beneficial organisms. Conservation may also entail providing habitat for beneficial organisms to increase their populations (Figure 4). For example, birds and bats, which often feed on pests, can be encouraged to inhabit the landscape by providing sources of water and shelter. In addition, flowers can be planted to provide pollen and nectar for the adults of many parasitic insects.

Augmentation of natural biological control entails the rearing and release of beneficial organisms to supplement existing populations in the landscape. Many types of beneficial organisms are commercially available for use in IPM programs, including lady beetles, lacewings, predatory mites, and parasitic wasps. Augmentation is a useful tactic in sensitive environments or where other control options are not feasible.

As with all pest control tactics, applied biological control has its limitations. It is important that the IPM practitioner and the client understand the limitations of these tactics. Compared to chemical control, biological control (particularly augmentation) is generally slower and less consistent in controlling pests. Whereas pesticides generally kill the targeted pest within minutes or hours of application, biological control can take days or weeks to suppress a pest population. During this period, the pest can cause considerable injury to infested plants. Other limitations of augmentation may include poor persistence, high cost, and incompatibility with other IPM control tactics. In general, conservation of beneficial organisms is the most effective biological control tactic.

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Figure 4. Biological control can be enhanced by providing habitat for the natural enemies of landscape pests.

Chemical Control

Chemical control tactics use pesticides for landscape pest management. Commonly used pesticides include insecticides, miticides, fungicides, bactericides, and herbicides. Chemical control is required when natural controls or other applied controls do not achieve the pest management objective. Pesticides are also used as a pest preventive tactic against certain fungal pathogens and insects that cannot be effectively treated following infestation. Preventive pesticide application should not be confused with cover spraying. Preventive application is performed only when landscape monitoring reveals that a pest is likely to infest desirable plants and cause intolerable injury. In contrast, cover spraying is performed with no regard to the identity of the pest or its potential to cause plant injury.

For effective, responsible pest management, IPM practitioners should follow this procedure when choosing a chemical control tactic:

1. Select an appropriate pesticide.
2. Use the correct pesticide dosage.
3. Apply the pesticide at the correct time and frequency.
4. Employ the correct pesticide application technique.

Pesticide selection is based on pest identification, host plant identification, environment sensitivity, and client expectations. Correct pest identification is paramount in pesticide selection. Correct identification confirms that the organism is the cause of plant injury and permits selection of a narrow-spectrum pesticide. Mixing several broad-spectrum pesticides together to target an unknown pest is expensive, environmentally irresponsible, and may even worsen the pest problem.

It is also important to identify the host plant correctly. Correct identification can prevent misapplication of pesticides to food-crop plants and plants susceptible to phytotoxicity. Moreover, it is illegal to apply a pesticide to a plant for which it is not labeled. Pesticide labels typically identify permissible plant use, sensitive plant species, and phytotoxicity risk factors. When in doubt about a specific plant application, consult the pesticide manufacturer or a local regulatory agency.

In highly sensitive environments, pesticide selection is particularly important. Clients often have specific expectations about pesticide use on their property. It is important to understand and accommodate these expectations in the IPM strategy. Low-toxicity, limited-persistence pesticides may be required by law or by clients for use around bodies of water, structures, or places where people congregate. Be aware that some pesticides are highly toxic to aquatic organisms, cause damage to structural surfaces, or emit offensive odors. Where practical, use trunk or soil injection techniques that limit pesticide exposure to the environment (Figure 5). Biorational control products (horticultural oil, insecticidal soap, insect growth regulators, botanicals, fermentation products, and microbial extracts) tend to be less toxic because they have short residual activity, unique modes of action, or target very specific types of pests.

IPM is an effective approach to managing landscape pests in a profitable, environmentally responsible manner. This series of articles has described the basic definitions, concepts, and practices of landscape IPM. With this knowledge, arborists can design, plan, and implement IPM

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Figure 5. Where practical, use trunk or soil injection techniques that limit pesticide exposure to the environment.

strategies as part of a comprehensive PHC program. Readers are encouraged to learn more about IPM and PHC through additional comprehensive resources.

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CEU TEST QUESTIONS

To receive continuing education unit (CEU) credit (1.0 CEU) for home study of this article, after you have read it, darken the appropriate circles on the answer form of the insert card in this issue of *Arborist News*. (A photocopy of the answer form is ***not*** acceptable.) A passing score for this test is 16 correct answers.

Next, complete the registration information, ***including your certification number***, on the answer form and send it to ISA, P.O. Box 3129, Champaign, IL 61826-3129. Answer forms for this test, **Integrated Pest Management: Tactics**, may be sent for the next 12 months.

You will be notified only if you do not pass. If you do not pass, ISA gives you the option of re-taking the quiz until you do achieve a passing score.

1. An effective landscape IPM program focuses on
   a. pest control
   b. pest prevention
   c. pest eradication
   d. pest cultivation

2. The basic goals of pest preventive tactics include
   a. minimizing plant stress by encouraging favorable conditions for plant development
   b. minimizing pest damage by using cover sprays
   c. minimizing pest activity by discouraging conditions favorable to pest development
   d. both a and c

3. Which of the following is not an abiotic stress agent?
   a. drought
   b. spider mite
   c. storm damage
   d. infertile soil

4. Reliable tactics for reducing both plant stress and pest activity include
   a. prescribed mulching, irrigation, and fertilization
   b. targeted plant selection and placement
   c. monthly fertilizer and broad-spectrum pesticide applications
   d. both a and b

5. IPM practitioners should always encourage clients to
   a. choose high-quality nursery stock
   b. diversify landscape plantings
   c. use pest-resistant plant species
   d. all of the above
6. Applied pest control tactics may be required when
   a. pest eradication has not been successful
   b. monitoring reveals that an action threshold has been exceeded
   c. an insect is seen on a landscape plant
   d. pest populations are being managed at tolerable levels
7. When selecting pest control tactics for an IPM strategy, arborists should consider
   a. the client's goals for landscape pest control
   b. the relative advantages and disadvantages of available tactics
   c. the potential impacts of available tactics on the landscape ecosystem
   d. all of the above
8. The typical pest control goal in landscape IPM is
   a. prevention
   b. eradication
   c. suppression
   d. none of the above
9. Eradication is a rare goal in landscape IPM because
   a. client needs can usually be fulfilled without eradication
   b. eradicating pests is often technically or economically impractical
   c. none of the above
   d. both a and b
10. Cultural control tactics are desirable because they
    a. are not lethal to landscape pests
    b. use only nontoxic pesticides
    c. have limited impact on nontarget organisms and the environment
    d. none of the above
11. Pruning types that are commonly used to control landscape pests include
    a. crown cleaning
    b. crown thinning
    c. topping
    d. both a and b
12. The removal of excessive plant litter to control a pest problem is called
    a. landscape sanitation
    b. yard waste reduction
    c. defoliation
    d. none of the above
13. Using predators, parasites, and pathogens as a means of managing landscape pests is called
    a. abiotic control
    b. biological control
    c. nonchemical control
    d. none of the above
14. The applied biological control tactic that purposely brings a pest's natural enemy into a landscape to replicate the natural means of pest control is called
    a. introduction
    b. augmentation
    c. conservation
    d. suppression
15. Conservation of natural biological control may be achieved by
    a. providing habitat for beneficial organisms, such as birds or bats, to increase their populations
    b. planting flowers to provide pollen and nectar for the adults of many parasitic insects
    c. careful use of pesticides that may adversely affect beneficial organisms
    d. all of the above
16. A common limitation of applied biological control is
    a. delayed or unsustained pest suppression
    b. introduced predators will start eating the plant once they eat all the pests
    c. many arborists are afraid to handle insect predators and pests
    d. none of the above
17. According to IPM principles, preventive pesticide application is performed only when
    a. a plant is introduced into a landscape that has a high susceptibility for pest infestation
    b. the arborist does not have time to monitor landscape pests
    c. monitoring reveals that a pest is likely to infest desirable plants and cause intolerable injury
    d. it is required by local ordinances
18. The most critical factor to consider when choosing a pesticide is
    a. pesticide application rate
    b. correct pest identification
    c. square footage of the area to which the pesticide will be applied
    d. level of residual duration desired
19. It is important to correctly identify pest-infested landscape plants because
    a. it is illegal to apply a pesticide to a plant for which it is not labeled
    b. misapplication to a food-crop plant could be a human health risk
    c. many plants are sensitive to pesticides and may have phytotoxic reactions
    d. all of the above
20. Pesticide exposure to the environment can be limited by
    a. using trunk- or soil-injection techniques
    b. cover spraying
    c. using a broad-spectrum pesticide
    d. avoiding biorational control products