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SP503-D-An Introduction to Integrated Pest Management of Landscapes

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Agricultural Extension Service
The University of Tennessee
SP 503-D

Insects

An Introduction to Integrated Pest Management of Landscapes

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A properly maintained landscape adds beauty and value to a property. Landscapes often contain a great diversity of plants and so have the potential to attract many pests. Fortunately, natural enemies of pests often regulate pest populations to low or moderate levels and chemical control is not needed. However, pests may still cause more damage than can be tolerated. We recommend using an integrated approach to managing pests.

This factsheet was written to familiarize the home or professional landscaper with the steps to using integrated pest management (IPM) in the landscape. Using this approach, you can manage damaging pests without disturbing the natural balances that exist between pests, natural enemies and the environment. Although pesticides play a role in this approach, it is important to understand the problems that may result when traditional chemical pesticides are used as the only means of defense against pests.

Problems with Reliance on Chemical Pesticides

Too often the first response to solving a pest problem is to reach for a chemical pesticide. Reliance on chemical pesticides in the landscape may have detrimental effects: (1) target pests may develop resistance to chemical pesticides, (2) surface water or ground water may be contaminated, and (3) non-target organisms such as humans, other mammals, birds, fish and natural enemies of pests may be adversely impacted by accidental exposure.

Development of Pesticide Resistance

Pesticide resistance occurs when pesticides are applied to pest organisms and some of them are not affected. These resistant individuals then produce young that may also be resistant. If the same pesticide or class of pesticides is repeatedly applied, the percentage of resistant individuals may increase (Figure 1). This is often the case when chemical pesticides are used in routine preventive spray programs. Over time, the pesticide is rendered ineffective against the target pest population.

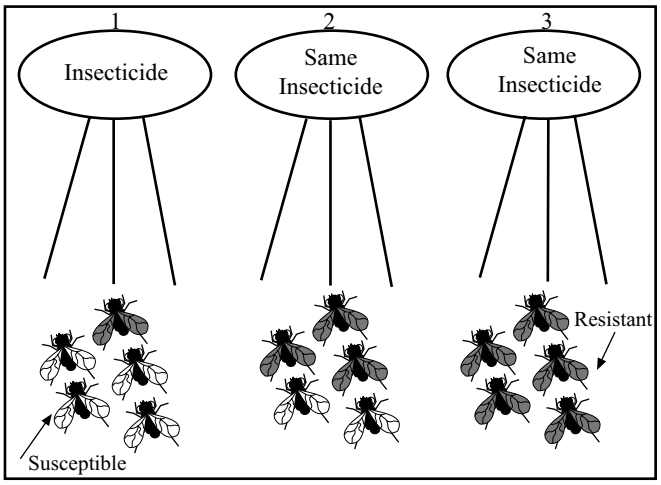

Figure 1. Development of resistance.

Potential for Water Pollution

Groundwater and surface water may be contaminated by pesticide spills, improper pesticide storage or disposal, or by leaching through soils or target site run-off after application. Pesticides in a drinking water supply can adversely affect human health in many ways, depending on the amount and type of pesticide present. Aquatic animals may also be adversely affected, as when fish are poisoned by inappropriately applied pesticides that enter a river system in run-off.

Exposure of Non-target Organisms

Animals may be unintentionally exposed to pesticides, although the pesticide application was targeted for another organism. These animals are called non-target organisms. Examples of this include the poisoning of fish mentioned above, and consumption by birds of a granular insecticide applied to the landscape for insect control. Natural enemies of pests, such as predators, parasites and pathogens, may also be killed by a pesticide application. In the absence of natural enemies, pests that are normally not important may increase in numbers and in pest status.

Humans can also be considered non-target organisms. In addition to pesticides accidentally introduced into water, humans may contact pesticide residues on ornamental plants or fresh fruits and vegetables. All pesticides applied to food must be applied a specified number of days before harvest so there is time for the pesticide to break down. Additional pesticide exposure may occur in the home environment when carpets are sprayed for flea control or when shrubs, lawns and other plants are sprayed for pests and people enter these areas before the pesticides dry. Humans are most at risk to pesticide exposure when they are mixing or loading pesticides. In addition, children may be accidentally poisoned when handling containers of unsecured pesticides around the home.

Not all pesticides are equally toxic. All pesticide containers have labels that carry signal words to indicate the degree of toxicity of their contents. The least toxic pesticides are labeled with a “caution,, signal word. Moderately toxic pesticides are labeled with a “warning,, signal word and highly toxic pesticides are labeled with a “danger,, signal word and a skull and cross bones symbol. The pesticide label also provides information on the chemical content of the pesticide, safety precautions, directions for use and for disposal of unused pesticide and the container. Always read and follow the directions on the label when mixing and applying a pesticide. Most people are aware that pesticides can be dangerous; however, not all people take adequate safety precautions when handling and applying pesticides. Further discussion on pesticide toxicity and safety are provided in the following Extension publications: PB 654*,* ***Safe Pesticide Practices***, PB 1352, ***Pesticide Use and Groundwater Protection*** and PB 1353, ***Factors Affecting Pesticide Movement to Groundwater*.**

Managing Landscape Pests Using The IPM Approach

Landscapes can be managed with minimal pesticide input in an IPM program. IPM emphasizes avoidance and prevention of damage by plant pests. This requires early detection and proper identification of damage, the responsible pest and natural enemies of the pest. Using all available information, one or more techniques can be chosen to provide pest control in an economical manner without risk to human health, property or the environment.

An IPM program can be broken down into four parts: (1) prevention; (2) detection and identification of host plant, symptoms, pests and natural enemies; (3) use of thresholds in decision-making; and, if necessary, (4) intervention.

1. Prevention. Proper landscape design (plant and site selection) can be used to prevent pest problems. Stress renders plants more susceptible to pests. The following are ways to decrease stress in plants and otherwise reduce or prevent their chance of being attacked by pests.

Proper Plant and Site Selection

Proper site and plant (variety) selection is easily done when designing a landscape. Many people inherit a landscape when purchasing a home, but can use the following advice when replacing plants.

- Do not plant species with a low pH requirement, such as azalea, near the foundation of a structure.

- Do not plant a species that needs a well-drained soil, such as juniper or yew, on a wet site.
- Understory plants are usually more adapted to shady conditions. For example, azaleas are more susceptible to azalea lacebug in full sun.
- Use species that are less susceptible to attack by pests, or resistant varieties of susceptible species.
- Plant turfgrass cultivars containing endophytes that control pests feeding on grass foliage.
- Locally grown, native plants may have adapted to native pest pressure as well as the local environment. However, this does not ensure they will be pest-free. Quite often, native plants have very specific environmental requirements that need to be observed when selecting a planting site.
- Observe the healthy plants growing near your site. This may help identify species well-suited to your environment, and those prone to pest attack.
- Plant together species that have the same fertilizer, pH, light and water requirements. This does not mean to plant all of one species in the same area. Species diversity in a landscape may make susceptible plants less visible to pests and provide habitat for a great variety of natural enemies.
- Proper spacing of plants is also important. Crowding can cause water and light stress, while too much space between plants may allow weed growth.
- Site preparation is also very important to healthy plant growth. Do not dig a nickel hole for a $10 tree. A general rule of thumb is to prepare a hole at least two times the size of the root ball.

Optimizing Growth

Ways to ensure optimal growing conditions include the use of mulch, proper pruning, watering and fertilizing.

- Recycled materials such as oak leaves and grass clippings can be used as a mulch. Spread 2 - 3 inches deep in beds, and around, but not touching, the base of trees and shrubs.
- Wounding of dogwood trees during weed removal or mowing causes them to be susceptible to attack by dogwood borer. Mulch around trees to prevent the chance of mechanical damage.
- Compost can be added to mulch. Place compost piles away from structures to discourage invasion of your home by potential pests originating from the pile.
- Composts added to lawns may suppress diseases such as dollar spot, brown patch, Pythium root rot, Typhula blight and red thread. Suppression of disease probably occurs because microbes from the compost compete with the disease pathogens for nutrients.
- Thatch is a layer of organic matter (undecomposed roots, rhizomes, stolons, plant crowns, stems and organic debris) between the soil and the green foliage of the grass. Do not allow the thatch layer of your lawn to become too thick. This can lead to disease problems, and prevent water, fertilizer and pesticides from reaching the soil. Thatch also harbors insect pests such as chinch bugs, sod webworms and cutworms.
- When pruning trees, cut branches just above the branch collar (i.e. where the branch connects to the trunk) to allow the tree to heal.
- Water and fertilizer should be applied at recommended rates. Too much of either results in succulent growth, making the plant more susceptible to pest attack.
- Excess fertilizer can lower the pH of the soil, resulting in decreased microbial activity. Earthworms that degrade thatch and aerate soil are fewer in acidic soils.
- Avoiding high levels of fertilizer also reduces the need for frequent pruning.
- Watering should occur during morning hours or late afternoon, preferably through drip irrigation, and foliage should be allowed to dry between waterings to prevent disease problems.
- Drought can also predispose plants to pest attack.

Further information on cultural practices for growing healthy plants can be found in the following Extension publications: PB 1163, ***Pruning Shrubs in the Landscape***, SP 287-C, ***Planting Balled & Burlapped Plants***, SP 287-D, ***Planting Bare-root Plants — Annual & Perennial,*** PB 1585, ***Flower Shade Gardening in Tennessee***, PB 713, ***Landscape Mulching Materials***, PB 837, ***Selection of Lawn Grasses for Tennessee,*** and PB 1211, ***Establishing a Lawn in Tennessee.***

2. Detection and identification of plants, symptoms, pests and natural enemies. In an IPM program, scheduled inspections are used, not scheduled sprays. Landscapes should be scouted regularly for pests, pest damage, natural enemies and conditions that may lead to pest problems. Early detection of pests can reduce the spread of the pest (thereby reducing the amount of pesticides used and the cost of control) and may allow for the use of natural enemies or other slow-acting, less toxic pesticides when there is not an imminent threat of damage.

Table 1. Early detection of pests.

Early detection of pests can:
1) reduce the spread of the pest,
2) thereby reducing the amount of pesticides used,
3) and the cost of control,
4) and may allow for the use of natural enemies or other slow-acting, less toxic pesticides when there is not an imminent threat of damage.

Pest Monitoring

Techniques available to monitor for pests include visual inspection of the plants, branch beating, pheromone traps (effective for lilac borer, ash borer, peach tree borer, rhododendron borer, Nantucket pine tip moth and dogwood borer); colored sticky traps and tapes (effective for whiteflies, aphids, leaf miners, leafhoppers, etc.); burlap trunk bands (gypsy moth); pitfall traps; soil corings (turf grubs); and soapy water flushes (chinchbugs, sod webworms, cutworms, billbugs). The emergence of pests can be predicted using mathematical models based on heat accumulation, especially during the winter and spring. Models have been developed for elm leaf beetle, bronze birch borer, flat-headed apple tree borer, dogwood borer, lilac borer, Nantucket pine tip moth, bagworm, San Jose scale, walnut scale, obscure scale and pine needle scale.

Plants that are more susceptible to pest attack are called 'key' plants. Key trees in many Tennessee landscapes are white pine, pecan, peach, crabapple, apple, flowering cherry and dogwood; the key shrubs are azalea, hawthorn, photinia, pyracantha, boxwood, rose and Euonymus.

Dormant-season inspections are very important to detect overwintering scale and mite infestations. Plants infested with scale insects can be marked with flagging tape and checked during the growing season for crawlers, the immature stage that is the most susceptible to insecticides. While scale insects can be treated with oils in the dormant-season, other insecticides are usually applied when the crawlers are present.

Spruce spider mites can be sampled from juniper, arborvitae, spruce or other conifers by branch beating; that is, striking a branch to dislodge the mites onto a sheet of white paper held beneath. The mites can be identified by using a finger to crush and streak the mite across the paper. If streak marks appear light green or tan, then they are probably spruce spider mites. Larger mites that do not crush easily feed on fungi and thus do not require control.

Landscapes should be monitored at least once every two weeks during the active growing season and several times during the dormant-season. Start your scouting program by drawing a map of your landscape, noting plant species and their locations. Indicating key plants, which are shaded in Figure 2, will make inspecting more efficient. Key plants should be inspected more closely and more often than others. A site history should be prepared, including past weather conditions, fertilizer and lime applications, irrigation and previous problems. This information may be useful in diagnosing pest problems. Further information on monitoring techniques is provided in the Extension publication, SP 370-H, ***Check Your Ornamental Plants*** and PB1578, ***Insect and Mite Pests of Ornamental Plants.***

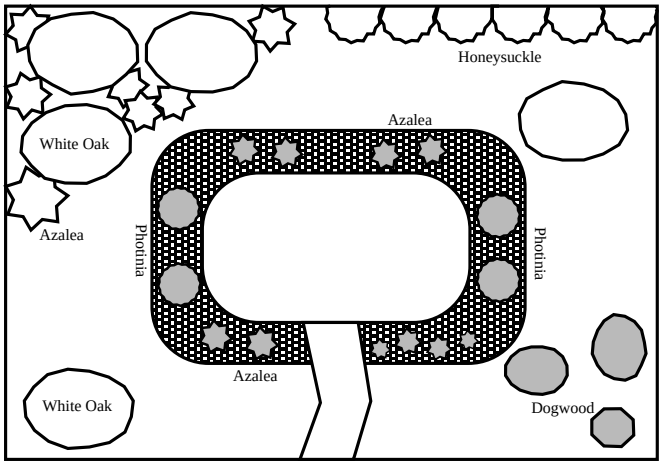

Figure 2. Map landscape plants and emphasize key species.

Identification of Pests and Natural Enemies

Proper identification of the pest and the lifecycle stage present is important for determining the timing and choice of control measures. Pests encountered in the landscape include arthropods (insects and mites), disease-causing organisms (bacteria, fungi, viruses, etc.), nematodes (microscopic worm-like animals), weeds (unwanted plants) and vertebrates (animals with backbones including moles, deer, chipmunks, etc.). Important, or 'key', pests of key plants noted above include azalea and hawthorn lace bugs, spruce and other mites, scales (Euonymus and tuliptree), borers, leafminers, Japanese beetle, aphids, bagworms, galls and weevils.

Learn to recognize all the stages of pests and natural enemies so that good bugs can be distinguished from bad bugs (Figure 3).

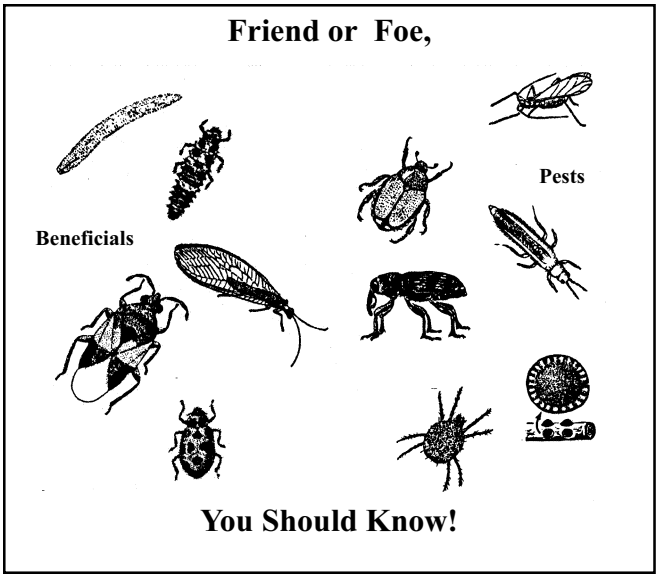

Figure 3. Friend or foe, you should know!

For instance, most people can identify the adult stage of the labybird beetle, but few can identify the larval stage, which resembles a very small (1/4 inch) black alligator. Pest control may not be necessary if natural enemies are abundant.

Identifying Signs and Symptoms

Often, a symptom alerts you to a problem when you have been scouting on a regular basis. For example, sooty mold on leaves indicates an infestation of sucking insects such as aphids. The sooty mold is a black fungus that grows on the honeydew secreted by these insects. Other indicators of pest problems may not be as obvious. Ants trailing into trees are probably 'tending' sucking insects such as aphids. To resolve the aphid problem, control of the ants may be necessary, because ants will often protect aphids from natural enemies. Other signs of damage include chewing marks, stippling or small light-colored spots on leaves, other unusual spotting of the foliage and webbing. The two-spotted spider mite and the southern red mite produce webbing.

It is important to first identify the possible causes of damage. For example, is plant damage observed due to insect damage or disease symptoms? Refer to identification keys and other sources for detailed information on pest identification and control. Various Extension publications are available with more detailed information on specific pests and diseases in addition to the more general publications, PB 1234, ***Disease Management of Woody Ornamentals in Nurseries & Commercial Landscapes***; PB 1589, ***Commercial Insect Control for Trees, Shrubs and Flowers***; SP 370-K, ***Identifying Problems of Garden Flowers***; PB 842, ***Turfgrass Diseases and Their Control***; and PB 1158, ***Lawn Insects: How to Control Them.***

3. Thresholds and decision-making. How do you know if chemical or other control is needed? The amount of plant damage considered tolerable, aversion to pesticides and cost of treatment are factors to be considered when making a control decision. Most homeowners are not particularly concerned with the value of their landscape plants, or don't draw a correlation between economic damage and amount of pest damage. Most homeowners are willing to accept as much as 10 percent damage as long as it does not detract from the appearance of the plant. When making control decisions, determine the level of defoliation considered tolerable and use that to determine when to apply control measures. Thresholds should be used when they are available. The number of grubs per square foot of turf that will cause damage is an example of a threshold. Keep in mind that mature trees can tolerate partial or complete defoliation; however, young trees are less tolerant and need to be protected.

4. Intervention — applying control measures.

Cultural Control

Many cultural control techniques that make the landscape less susceptible to pest damage were presented in the **Prevention** section. Proper plant selection and siting promote optimal growth and minimize plant stress, resulting in a landscape that is less conducive to pests. Mulching, composting, proper plant culture and removal of thatch are all practices that can reduce pest attack.

Mechanical Control

Mechanical control techniques are nonchemical means of killing pests, or removing or excluding them from an area. Removing pests from plants by hand is useful when the pests are fairly large and accessible, such as caterpillars on short plants. Pruning can be used to remove infested or infected branches from a tree or shrub. Sticky traps can remove a proportion of a pest population, but will rarely eliminate an infestation. Sticky traps are best used as indicators of the presence of a pest rather than as a control mechanism. Burlap bands are placed around tree trunks to provide refuge for gypsy moth larvae climbing up the trunk. During light-to-moderate infestations, the larvae feed on foliage in the canopy at night and descend the trunk in search of refuge at dawn. Larvae collected in the burlap bands can be destroyed by crushing or by submersion in soapy water. Newly-hatched gypsy moth larvae disperse by releasing a silk thread that is caught by the wind, carrying the larvae to another tree or the ground. Sticky bands (composed of Vaseline® or Tree Tanglefoot® applied to the sticky side of duct tape) placed around the trunks of susceptible trees can prevent newly-hatched gypsy moth caterpillars from climbing the tree.

Biological Control

Biological control is the use of natural enemies, such as predators, parasites and pathogens, to control unwanted organisms. This includes use of syrphid flies, lacewing larvae, *Trichogramma sp.,* lady bird beetles, insect-killing nematodes, pathogenic fungi and predatory mites. Although many homeowners think exclusively of biological control when IPM is mentioned, it is just one component of an IPM program. When agricultural pests migrate into a home landscape, they often are followed by their natural enemies. An IPM program should conserve natural enemies in the landscape by reducing the amount of pesticides applied. Flowering plants may enhance the control of pests by providing a food source, such as pollen or nectar, for natural enemies. For natural enemy sources, refer to ***Commercial Sources of Predators, Parasitoids and Pathogens*** (SP 290-Z). One can create habitat for insect-eating birds by leaving standing dead wood for nest cavities. But be careful, habitat for "useful,, wildlife may also provide habitat for unwanted wildlife.

Chemical Control: Biorational Or "Green" Pesticides

Biorational pesticides are substances that have the desired effect on target pests with minimal adverse effect on non-target organisms. Examples include insect pheromones, insect growth regulators, microbials, botanical insecticides, insecticidal soaps and horticultural oils. Timing and placement of biorational pesticides are crucial for avoiding effects on non-target organisms.

Pheromones. Pheromone traps are useful for monitoring pest infestations and may also reduce populations. Pheromone traps typically will only attract the species or group of closely related species that use a specific pheromone. Usually they attract and trap or confuse the male insect, thereby preventing it from mating with a female.

Insect Growth Regulators (IGRs). IGRs are believed to be less toxic to mammals because some mimic the action of insect hormones that are not present in mammals. Insect growth regulators such as fenoxycarb (Precision, Award), cyromazine (Citation), kinoprene (Enstar II - for greenhouse and interiorscapes) and azadirachtin (neem products - Azatin-XL) cause immature insects to die before becoming adults. Some may reduce the reproductive potential of the adult females. Negative effects on natural enemies are usually considered minimal. Azadirachtin compounds are also insect repellents.

Microbials. Microbial insecticides such as *Bacillus thuringiensis* (Bt) contain toxins derived from bacteria with activity that is fairly specific to the target insect pest. *Bacillus thuringiensis* subsp. *kurstaki* (Dipel and others) is specific to caterpillars (moths and butterflies). *Bacillus thuringiensis* subsp. *tenebrionis* (M-Trak, Novodor) is toxic to Colorado potato beetle and some types of leaf beetles, such as elm leaf beetle, that feed on ornamental plants.

Entomogenous nematodes such as *Steinernema carpocapsae* (Vector TL) can be applied to the lawn to control pests such as flea larvae and cutworms, or sprayed on tree trunks to control peachtree borers and dogwood borers feeding beneath the bark. *Beauvaria bassiana*, a fungal pathogen of insects, is sprayed on ornamental plants (Naturalis-O) or lawns (Naturalis-T) to control a variety of insect and mite pests.

Insecticidal soaps and botanical insecticides. The advantages of using insecticidal soaps (soaps that contain sodium or potassium salts of fatty acids) or botanical insecticides (naturally occurring plant compounds that have insecticidal activity) are their rapid degradation in the environment (with potentially less impact on nontarget organisms), rapid effects on target organisms, typically low mammalian toxicity and usually no toxicity to plants. Soaps disrupt the cell membranes of soft-bodied insects and mites such as aphids, soft scale, caterpillars, spider mites, beetle larvae and mealybugs. They must contact the pest to be effective, so adequate spray coverage is essential.

It is difficult to generalize about how the available botanical insecticides work. Examples include azadirachtin compounds and pyrethrum. Many people incorrectly assume that a natural compound is inherently a safe compound. Nicotine, a naturally-occurring compound that is the active ingredient of a botanical insecticide, is highly toxic.

Oils. Horticultural oils cause death to pests by disruption of cell membranes and/or slow suffocation, so adequate spray coverage is essential. They are used against aphids, mites and scale insects. Horticultural oils have little effect on humans except to cause occasional skin irritation. Because there is potential toxicity to plants, it is important to check the label to determine if the plant to be treated is listed as susceptible to damage.

Systemic Insecticides. A systemic insecticide or miticide is absorbed by the plant and translocated to different parts of the plant. Advantages of systemics are that some new growth can be protected without additional treatments, natural enemies generally are not exposed to the chemical and the pesticide is not exposed to environmental conditions that would cause it to be washed from the plant or degraded to a ineffective form. An example of a systemic insecticide is imidacloprid, which belongs to a new class of pesticides, the chloronicotinyls. Imidacloprid is available as a wettable

powder, granular or injectable, and can be taken into the plant by the foliage or by the roots, depending on the formulation. Root uptake is the most effective and long-lasting application method. Once inside the plant, the target pest must feed on the plant to get a toxic dose. Other systemics are available.

Traditional Pesticides

Several negative aspects of using pesticides have been given. Sometimes broad-spectrum pesticides are necessary because there are no known alternative control procedures, or other known procedures are less effective. If possible, when choosing a pesticide, choose the least toxic one with the signal word 'caution'. Treat only affected areas, plants or plant parts, instead of large areas. This will reduce exposure of non-target organisms and reduce the possibility of environmental contamination. Please refer to the current year's ***Insect and Plant Disease Control Manual*** (Entomology and Plant Pathology Info #67) for pesticide recommendations for the plant and pest of concern.

Summary

We hope the information above can be used to increase or maintain the beauty of your landscape. IPM control practices are designed to reduce unnecessary pesticide exposure to people, property and the environment, while providing excellent pest management. Follow prevention practices whenever possible, especially when designing or redesigning a landscape. Regularly inspect the landscape and learn to identify pests, their damage and their natural enemies.

Ask yourself these questions as you locate pests, their damage and their natural enemies. Is the damage tolerable? Are sufficient numbers of natural enemies present to eventually reduce the pest populations to tolerable levels? Were flowers planted to provide nectar and pollen sources to keep natural enemies in your landscape? Can the pest be picked or pruned off? Is it possible to plant resistant varieties the next time?

If pesticides are needed, use biorationals such as insecticidal soap or horticultural oils to reduce potential effects on natural enemies. Avoid broadcast sprays if spot-treating the affected areas will provide the same control. Application timing is very important to achieving control. Pesticides should be applied when the most susceptible stage of the pest is found. Finally, when using pesticides, always read the label!

Details of the subject matter introduced in this factsheet will soon be available in an extensive Extension publication. Check with your county Extension agent for it's availability.

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POISON INFORMATION
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ATTENTION

1. Read the label of any pesticide before applying.
2. Do not rely on pesticides alone; employ all cultural methods of control.
3. Regulations and guidelines concerning use of pesticides are subject to change without notice. Consult the label of the product for usages and rates before applying. If recommendations in this manual conflict with the label, please follow the label instructions.
4. When a range of rates and application intervals are recommended, use the lower rate and longer interval for mild-moderate infestations and the higher rate and shorter interval for moderate-severe infestations.
5. Use of trade or brand names in this manual is for clarity and information.The Tennessee Cooperative Extension Service does not imply approval of the product to the exclusion of others which may be similar, suitable composition, nor does it guarantee or warrant the standard to the product.
6. Please read the label before using a product.

Precautionary Statement

To protect people and the environment, pesticides should be used safely. This is everyone's responsibility, especially the user. Read and follow label directions carefully before you buy, mix, apply, store, or dispose of a pesticide. According to laws regulating pesticides, they must be used only as directed by the label. Persons who do not obey the law will be subject to penalties.

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