



# PURDUE PESTICIDE PROGRAMS

Purdue University Cooperative Extension Service

## PESTICIDES AND PEST PREVENTION STRATEGIES FOR THE HOME, LAWN, AND GARDEN

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## INTRODUCTION

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A family on a camping vacation applies mosquito repellent. Suburban homeowners spend Saturday morning spreading weed-n-feed products on their lawns. An apartment dweller cleans the bathroom with bleaches and disinfectants. Parents sprinkle a few mothballs into boxes while packing their children's winter clothes for storage.

What activity do these people have in common? They're all using pesticides. However, they may not recognize the products they are using as pesticides.

### **What are pesticides?**

In simple terms, pesticides are chemical compounds used to control pests. Examples include insecticides, which control insects; rodenticides, which control rodents; fungicides, to control the spread of fungal diseases of plants; and herbicides, which control weeds and other plants.

### **Why are pesticides important?**

Pesticides control insect pests and diseases of food and fiber crops, thus improving the quantity and quality of the end products. Some are used to control parasites on farm animals and pets. Others help maintain our health; e.g., disinfectants are used to cleanse kitchens and bathrooms, and repellents are functional in warding off ticks that carry disease.

### **Are pesticides necessary?**

Sometimes pesticides are necessary, but not in every pest situation. Many times, non-chemical control methods may be preferable; other times, it may be possible to employ alternative methods to prevent pest damage. It is prudent to know and understand all available options in a given situation in order to reduce pesticide use.

### **What is the purpose of this publication?**

This publication presents various pest prevention and control programs which can be employed in the home environment. Home, food, health, pet, wildlife, flower and vegetable garden, fruit and shade tree, and turf pest situations are addressed.

## PEST MANAGEMENT STRATEGIES

The first step in pest management is to identify the pest that is causing the problem. It then becomes essential to learn about the life cycle and behavior of the pest to facilitate the development of a plan to manage it; the goal might be eradication or merely the reduction or suppression of its damage potential.

A good pest management strategy incorporates some or all methods available to manage a given pest. This is called *integrated pest management, or IPM*. The goal should be to reduce pest populations and damage to economically and aesthetically tolerable levels. Complete eradication may not be possible, practical, or desirable.

Judicious selection of pest control methods should be aimed at reducing or eliminating pesticide use whenever possible. This is important because of concerns about personal and environmental safety. The following methods should be considered in developing a pest management strategy.

### **Exclusion**

One of the safest and most effective ways to manage pests in the home environment is to deny them access. This is called exclusion, or pest-proofing, and may be accomplished via one of the following options.

#### ***Exclusion by Regulation***

Government embargoes and quarantines which prohibit the introduction of pests into one country from another—or into one locality from another—are methods of exclusion by regulation. A case in point is the quarantine that prevents pine trees infested with European pine shoot beetles from being transported into Indiana counties known to be free of that insect.

#### ***Mechanical Exclusion***

Barriers and devices such as fences, traps, lights, row covers, and noisemakers are examples of mechanical exclusion methods used to keep pests away from garden plants and out of homes. For example, nuisance wildlife such as rabbits can be excluded from gardens and landscape plantings with fencing. Some insects can be kept away from vegetables by covering them with a row cover made from a special kind of fabric. Birds can be banished from fruit crops by covering trees, bushes, or vines with plastic netting.

Rodents and other mammals such as bats can be excluded from homes by permanently closing entrance

holes with caulking, steel wool, or structural repairs. Many insects can be kept out by caulking holes and cracks and ensuring that doors and windows are tightly sealed and screened. The use of yellow light bulbs (instead of the more conventional white bulbs) outside entrances will attract fewer kinds of insects. Storing food products and pet food in tightly sealed containers will guard against other insect and rodent infestations.

Glue boards for cockroaches and traps for wildlife are other examples of devices that can be used to keep pests away from homes and plants. The force of water can be used to dislodge insects such as aphids from host plants; such slow-moving insects often simply die before they have a chance to crawl back onto the host.

One word of caution: Some exclusion devices—such as those that produce sounds audible only to insects or rodents, and light traps that electrocute insects—have not been proven effective.

## **Cultural Control**

Most plants and animals resist pests best when they are in good health. Therefore, keeping a potential host healthy can help prevent pest damage.

### *Plant Selection*

It is important to select species and cultivars of crops and ornamental plants recommended for the locale. Neighbors and professionals in the community should be consulted to determine which kinds of plants grow best and without significant pest problems. Avoid those that are known to have a questionable history and those recognized as marginally hardy. Cold temperatures can predispose tender woody and perennial plants to pest damage; choosing a hardier variety would be an example of cultural control through plant selection.

The European white birch tree is a beautiful tree and a popular choice for the residential landscape. However, it does not grow well in Indiana's climate; summer soil temperatures are too high, causing an unhealthy root system. The weakened tree then becomes susceptible to bronze birch borers that damage and usually kill it. Maintaining a European white birch tree in Indiana nearly always requires annual applications of an insecticide to control the borers. The frustration, expense, and hard work can be avoided by selecting a river birch, which is not susceptible to the borer, thereby eliminating the need for pesticide application. This, too, would constitute cultural control by plant selection.

Some plant cultivars resist or tolerate pest damage. Examples include tomato cultivars that are resistant to wilt diseases, apple cultivars resistant to scab

diseases, and plants bred to produce more surface hairs that will discourage insect feeding. Cultivar selection should be based on the plants' known resistance to common pest problems, thus limiting loss potential and reducing the likelihood that a pesticide application might be needed.

### *Planting Dates*

There are recommended planting intervals for most crops, and it is wise to recognize their importance. Careful selection of planting dates enhances crops' defenses against disease and insect infestations. Planting too early in the spring can result in plants weakened by cold, wet soil conditions; and late spring frosts can damage or kill crops planted too early. Root and seed rots usually can be avoided by choosing later planting dates that lend more favorable soil conditions. Certain insect pest problems can be avoided by choosing appropriate planting dates. Growing a combination of early, mid, and late season crops may decrease the potential for losses due to pests, based on the resulting staggered dates of maturity; i.e., a pest present at a given time wouldn't be apt to affect all three stages of growth. Careful selection of planting dates is a form of cultural control.

### *Crop Rotation*

If space permits, crops should be rotated to different areas of the garden each year to prevent buildup of pests in the soil.

### *Sanitation*

Sanitation is perhaps the most important cultural practice that can be used to help manage pests. It consists of removing plants or plant parts suspected of harboring insects or disease. For example, affected leaves, twigs, and branches of dogwoods infected with anthracnose should be removed and destroyed to help prevent the disease from spreading. Another example is the removal of certain plant parts that may be diseased, such as fallen rose leaves that are infected with black spot. It is important to always buy healthy seeds and plants known to be free of insects and disease. Examine 'gifts' from neighbors and tactfully decline those which obviously display pest symptoms. Remove garden weeds before they mature and produce seeds, and add them to your compost pile.

Sanitation is also important at the end of the growing season. Plant residue from annual crops, as well as the tops of herbaceous perennials, should be removed from the garden in the fall. Those not infested with insects or infected with disease can be added to a compost pile.

Other examples of cultural control through sanitation include removal of dead or diseased limbs from trees and shrubs; garbage management to discourage flies and rodents; careful attention to pet food areas; scrupulous cleanup of food crumbs in the home; and elimination of paper bags, newspapers, and other materials that provide food and shelter for pests such as cockroaches and rodents.

### *Other Cultural Methods*

Good cultural practices include providing plants the best possible growing situation: proper spacing, watering, and fertilization. Weed control and the timely harvesting of produce also help to maintain healthy plants. The control of weeds with organic mulch is a good cultural practice, and mulch also contributes to plant health by moderating soil temperatures and conserving moisture.

Manipulation of a pest's environment also can be an effective method of cultural control. For example, venting the crawl space beneath a house will allow the space to dry, rendering the area unfavorable for the development of allergy-causing mildews and wood destroying organisms such as termites and decay fungi.

## **Biological Control**

Biological control utilizes the natural pathogens, predators, or parasites of a particular pest. One example is encouraging predatory lady beetles to destroy aphids in the garden. A biological approach might include growing certain plants as shelter or nectar sources for other predatory insects.

## **Chemical Control**

Chemicals have been used for hundreds of years to control pests. Pesticides are chemical compounds formulated to control pests; roach sprays, weed killers, and rat and mouse baits are modern examples. Household and industrial cleaning products that kill germs are also pesticides, as are common bleaches as well as chemicals used to sterilize surgical tools and surfaces in hospitals.

Pesticides can consist of one or more active ingredients, and the active ingredients can be either organic or inorganic. Organic compounds are based on carbon chemistry and are formulated from molecules that contain carbon, hydrogen, and oxygen. Some organic compounds used in pesticides occur naturally and are obtained from plants or bacteria; these are called natural, biological, or botanical pesticides.

The organic active ingredient in pyrethrin insecticides is obtained from a certain chrysanthemum flower.

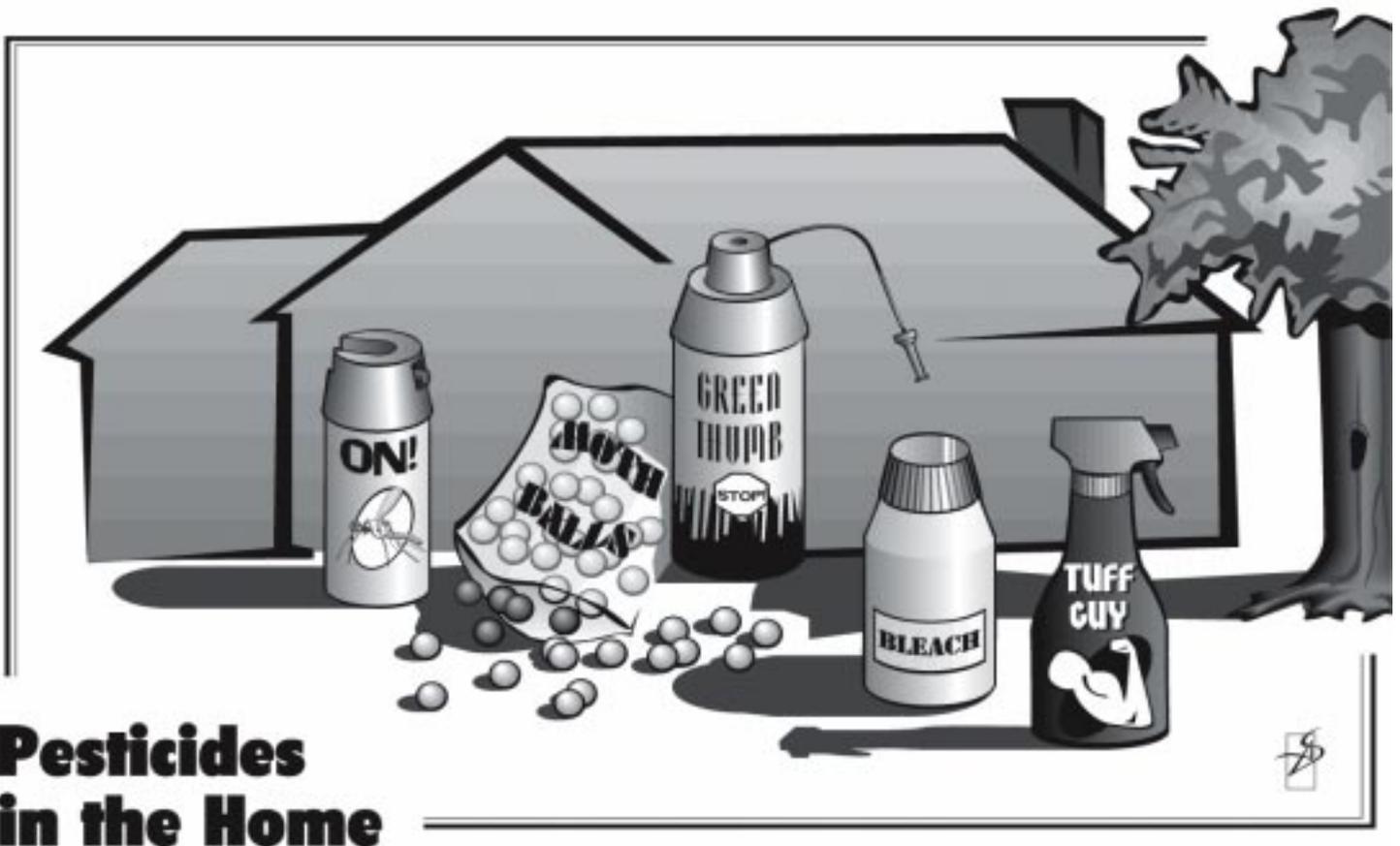
Pyrethrins often are used to control flying and crawling insects in the home, as well as on pets and garden plants.

Inorganic compounds do not contain carbon but are derived from mineral sources. Some inorganic compounds used in pesticides also occur naturally. An example is a copper-based product used for algae control in ponds.

Pesticides containing synthetic (manufactured) compounds comprise the largest number of products used to control pests. Most synthetic pesticides consist of organic compounds, and these represent the group that most people consider when contemplating the use of pesticides.

Many synthetic pesticides have a mode of action similar to that of natural pesticides. Both natural and synthetic pesticides can vary in their toxicity to people and pets. Don't assume that just because a pesticide is 'natural' it is not toxic; conversely, some natural pesticides can be quite toxic. Always read the product label and follow the precautions stated. Follow all instructions carefully.

Some pesticides control pests without killing them. Following are examples of pesticides that provide pest control alternatives.



## Pesticides in the Home

### ***Repellents***

Topical products which lessen human attractiveness to ticks, chiggers, mosquitoes, biting flies, etc., are called repellents. They help make outdoor activities more enjoyable and contribute to the prevention of diseases transmitted by certain insects. Lumber treated with wood preservatives extends the lifetime of outdoor structures and furniture by repelling wood destroying organisms. Repellents can be used to discourage deer from feeding on the bark of valuable trees.

### ***Attractants***

Chemicals used to lure pests into a trap are called attractants. For instance, an insect sexual attractant (called a pheromone) may be used inside a plastic bag, luring Japanese beetles inside. When the bag becomes filled with beetles, it can be tied off and discarded. However, Japanese beetle traps should be used with caution; since they work by *attracting* the beetles, one might end up with more beetles—instead of fewer—if they were the only person in the neighborhood using the traps. Everyone in the neighborhood should use them simultaneously to be effective; and it is important to place the traps far away from potential host plants.

Other examples of attractant devices are yellow jacket traps, glue boards for cockroaches, and traps used to monitor the presence of other insects.

### ***Growth Regulators***

Pesticides developed to adversely affect the growth of specific insects are categorized as growth regulators. They work by preventing the immature stages of certain insects from maturing into adults, or by rendering adults sterile or killing them. Some flea and roach products are growth regulators.

### ***Desiccants***

Insects that contact desiccants usually die. For example, a silica material called diatomaceous earth, commonly used in swimming pool filters and also helpful in managing garden slugs, is abrasive to the outer covering of some insects; the abrasive action dehydrates the pest, resulting in death.

### ***Home Remedies***

Some people try to formulate their own pesticides, using household products. This can be a dangerous practice. Many household chemicals are toxic, and mixing several of them together can result in combinations that are injurious to people, pets, and plants. This is especially true when the concoctions are applied to food crops. Remember that home remedies have not

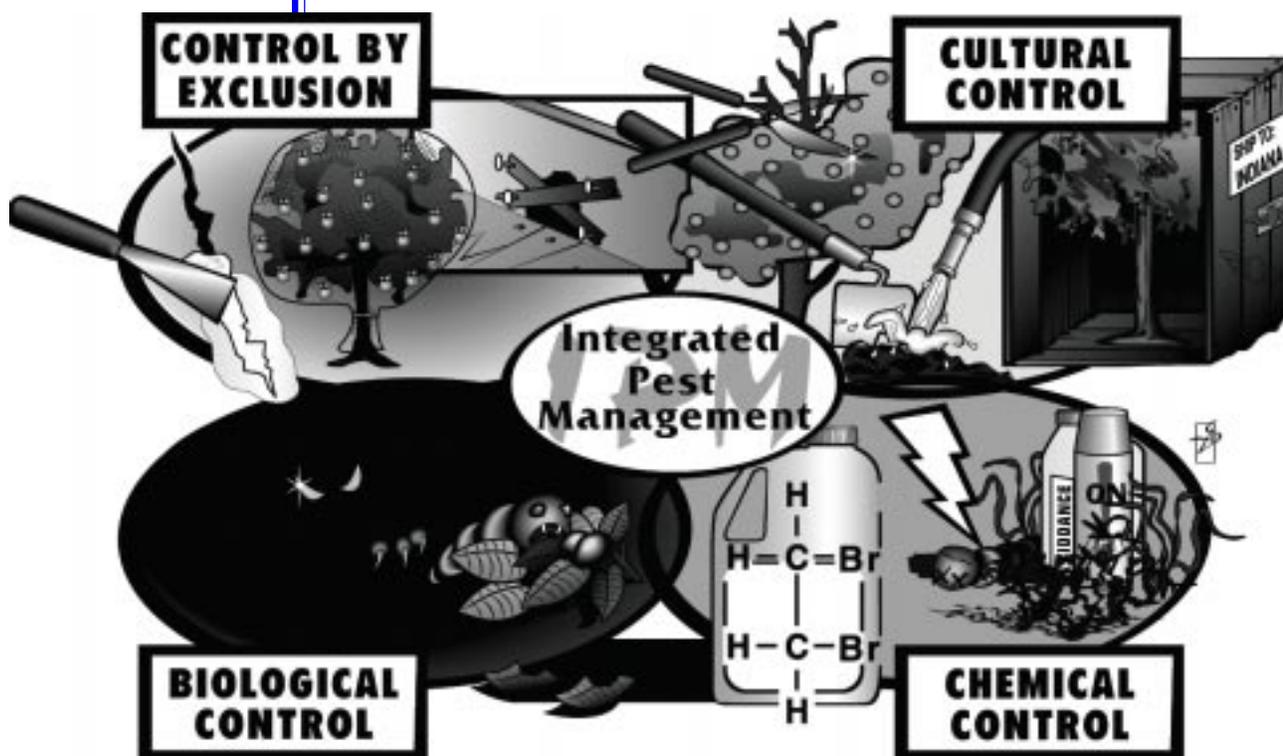
been tested and registered by the Environmental Protection Agency. Don't gamble with them!

## DEVELOPING A STRATEGY

When various pest management strategies—exclusion, cultural control, biological control, and/or chemical control—are used in conjunction with regular inspections of the home environment to monitor and manipulate pest activity, the process is recognized as integrated pest management; in most cases, an IPM approach is considered sensible and environmentally sound and will keep pest levels and damage below economically or aesthetically injurious levels.

Although it is extremely important to remember that total eradication of a pest population is not the goal in most cases, it is equally important to recognize that sometimes it is. Eradication is by all means desirable when termites are damaging a structure or when pests present the possibility of disease transmission to people or pets.

A preferred strategy in most pest control situations is to think in terms of reducing pest activity to a level



which poses only minimal potential for damage to or annoyance of the host, be it plant, animal, or structure. For instance, it is not necessarily desirable to kill all spiders in the home environment; most of us are willing to tolerate a spider here and there, but we're not willing to share our kitchens with even a single German cockroach or mouse.

Effective pest management and reduced use of pesticides are compatible. Pesticides used correctly and judiciously are good tools for pest control. However, they should not be used if non-pesticidal approaches can solve the problem.

Selection of the most appropriate pest management method in a particular situation should be preceded by accurate pest identification and a survey of the site to determine the exact location and extent of the pest population. Pest management based on limited pesticide use requires learning as much as possible about the pest and how it survives in the home, lawn, or garden. In some cases, successful pest management strategies require patience, persistence, and long-term commitment.

**Persistent pest problems may necessitate consulting a pest management professional who is properly trained to identify pests and provide the safest, most cost-effective approach for control or elimination.**

## **A STRATEGY FOR LAWN PEST MANAGEMENT**

Healthy turf can compete with weeds, survive insect attacks, and fend off disease. But the key is to create an optimum environment where grass plants have every advantage for vigorous growth. The following suggestions can assist the homeowner in establishing and maintaining healthy turf with no (or minimal) use of pesticides.

### **Choose an Adapted Grass with Pest Resistance**

Select grass species and cultivars that are insect and disease resistant. Choose those that are best adapted to grow under the sun or shade conditions of the landscape. The amount of maintenance which will be required and the intended use of the turf also should be considered in the selection process.

Grasses recommended for Indiana lawns include the 'cool season' Kentucky bluegrasses, turf-type perennial ryegrasses, fine fescues, and turf-type tall fescues.

In southern Indiana, the 'warm season' zoysia grasses may be desirable, although they are slow to

green up in the spring. Other species recommended for southern Indiana include the turf-type tall fescues for sunny areas, and mixtures of Kentucky bluegrasses, turf-type perennial ryegrasses, and fine fescues for lightly shaded areas.

In northern and central Indiana, Kentucky bluegrasses and turf-type perennial ryegrasses perform best in sunny locations; the turf-type tall fescues are worthy of trial for high traffic areas; and fine fescues are good to include in mixtures for lightly shaded areas.

Always blend two or three cultivars of each species included in a mixture of seed for lawn turf to provide better disease resistance and adaptation to the site. Planting a single cultivar invites problems.

Homeowners with many large trees in their landscapes often become frustrated because it is difficult to grow a beautiful lawn in heavy shade. The grass plants gradually disappear and weeds, moss, and algae take over. Designing a woodland garden for such problem areas would be a better choice than chemical control of pests. Use ground covers, perennial flowers, and shrubs that are adapted to heavy shade. Combine these with mulch, decks, outdoor furniture, and other accessories to create a pleasant retreat. Consult landscape architects and designers for assistance in making the project a success.

## **Seed the Lawn When Conditions are Favorable**

The best time to plant cool season grasses in Indiana is late summer when regular rainfall, moderate temperatures, and minimal weed competition favor the germination and establishment of grass plants.

Lawns in the northern half of Indiana should be seeded with cool season grasses between August 15 and September 15, and those in the southern half between September 1 and September 30. Cool season grasses also can be seeded in the spring, although more irrigation and more herbicides for weed control may be required. Zoysia grass is usually started from plants rather than seed; the 'plugs' or 'sod strips' of zoysia grass should be started in late spring.

## **Determine the Lawn's Needs with a Soil Test**

Lawn grasses require ample nutrients for healthy growth and resistance to pest damage. Test the soil about every three years to identify nutrient deficiencies and changes in soil acidity. A routine soil test will determine the soil's pH (acidity or alkalinity), its lime index, and its levels of phosphorous and potassium. If requested, the results will be accompanied by a

recommendation for fertilizing the lawn. Never add lime to a lawn unless a soil test determines the need. County Cooperative Extension Service or garden store personnel can identify soil testing laboratories in the area.

## **Fertilize the Lawn for Sustained Growth and Reduced Pest Competition**

It is important to understand how nutrients are packaged in fertilizer products. The three numbers on the label are required by law to inform the consumer of the percentage (by weight) of nitrogen, phosphorous, and potassium in the package. The numbers 24-6-12 on a fertilizer label indicate that the product contains 24% nitrogen, 6% phosphorous, and 12% potassium (potash). A good lawn turf fertilizer contains a nutrient ratio of about 4 parts nitrogen, 1 part phosphorous, and 2 parts potassium. It is normally recommended that the fertilizer product used for routine maintenance of a lawn provide two to four pounds of nitrogen per thousand square feet of lawn per year.

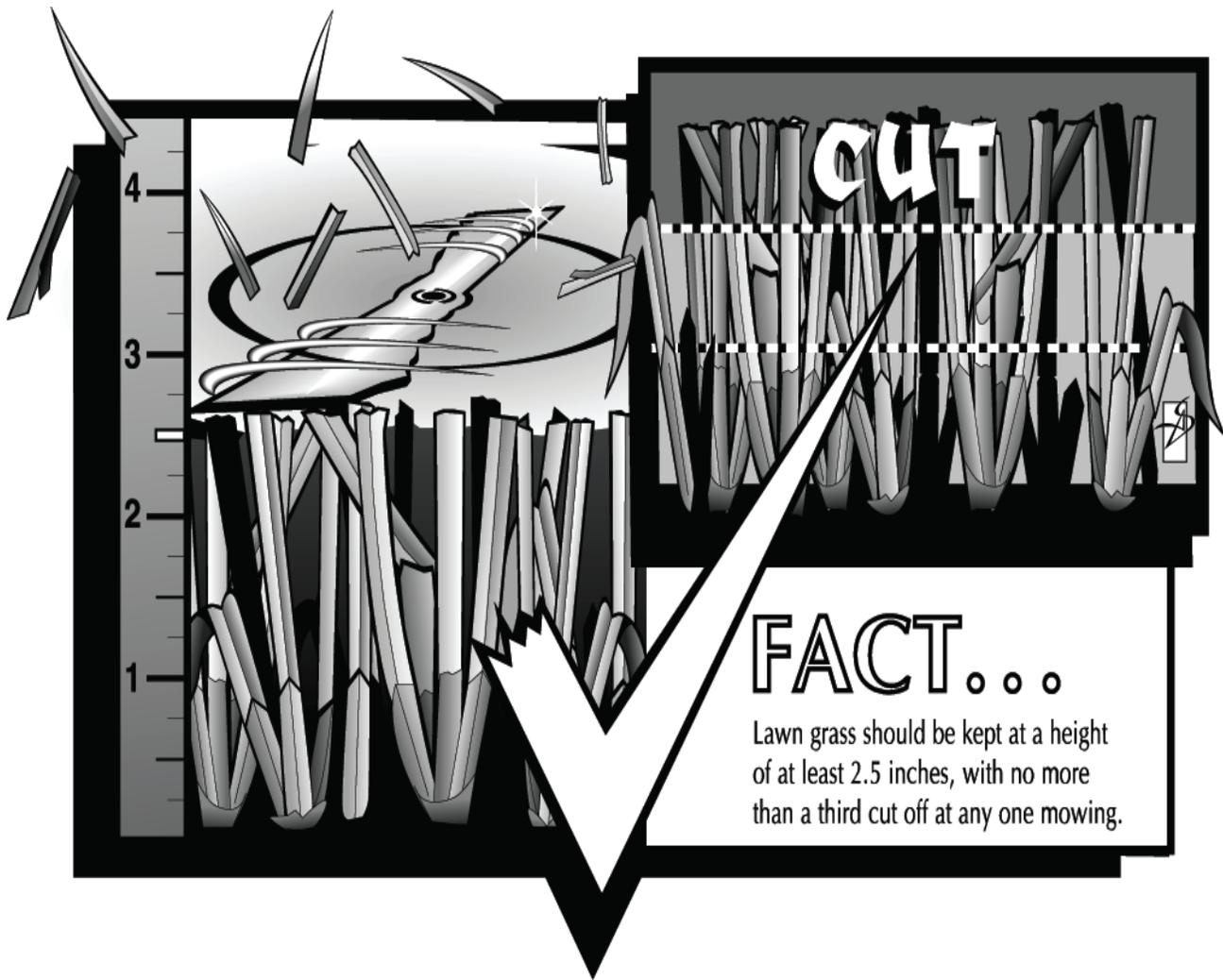
Fall applications of fertilizers are best for cool season grasses. Two-thirds of the annual nitrogen requirement for a lawn should be applied in the fall, followed by the remainder in mid to late spring. Fertilizers should not be applied too early in the spring because they will promote lush growth that is more susceptible to disease. Zoysia grass should be fertilized only in late spring or summer.

## **Mow Properly for a Healthy Lawn and Fewer Weeds**

Improper mowing practices result in more damage to lawns than any other cultural factor. Many lawns are mowed too short, infrequently, and with a dull blade. This restricts root growth and increases insect, disease, and drought damage, resulting in more weeds.

The grass species in a lawn should determine the mowing height. Kentucky bluegrass, turf-type perennial ryegrass, and fine fescues should be mowed at least 2.5 inches high. A mowing height of at least 3 inches is best for turf-type tall fescues.

Mow often so that no more than 1/3 of each leaf blade is removed each time the grass is cut. This may mean mowing several times each week in the spring and fall, but usually only weekly or biweekly in the summer. Lawns should be mowed about 1/2 inch higher in summer to help grass plants tolerate heat and drought stress. Always mow with sharp blades. Leave the clippings on the lawn unless they are needed for mulch or compost. This important practice will return nutrients to the soil to be taken up by the grass plants;



## FACT...

Lawn grass should be kept at a height of at least 2.5 inches, with no more than a third cut off at any one mowing.

rake or recut the lawn. Frequent mowing when the lawn is dry helps disperse the clippings properly.

### **Reduce Diseases and Weeds with Proper Irrigation**

Improper watering is the second largest cause of lawn pest problems. Irrigation for established lawns should be thorough, with each watering wetting the soil about 6 inches deep. Watering should not be repeated until the turf begins to show signs of drought stress, such as a bluish-gray color or footprints that do not disappear as someone walks across the lawn. Such signs are not cause to worry; the grass can withstand mild stress and will recover when watered thoroughly again.

It is best to water between 4 and 8 A.M. because the evaporation rate is low early in the morning, allowing most of the water to soak into the soil; and in urban areas this is when municipal water pressure is highest. Midday watering is not advised due to the likelihood of rapid evaporation. Watering late in the evening is not advisable because flowers and other landscape

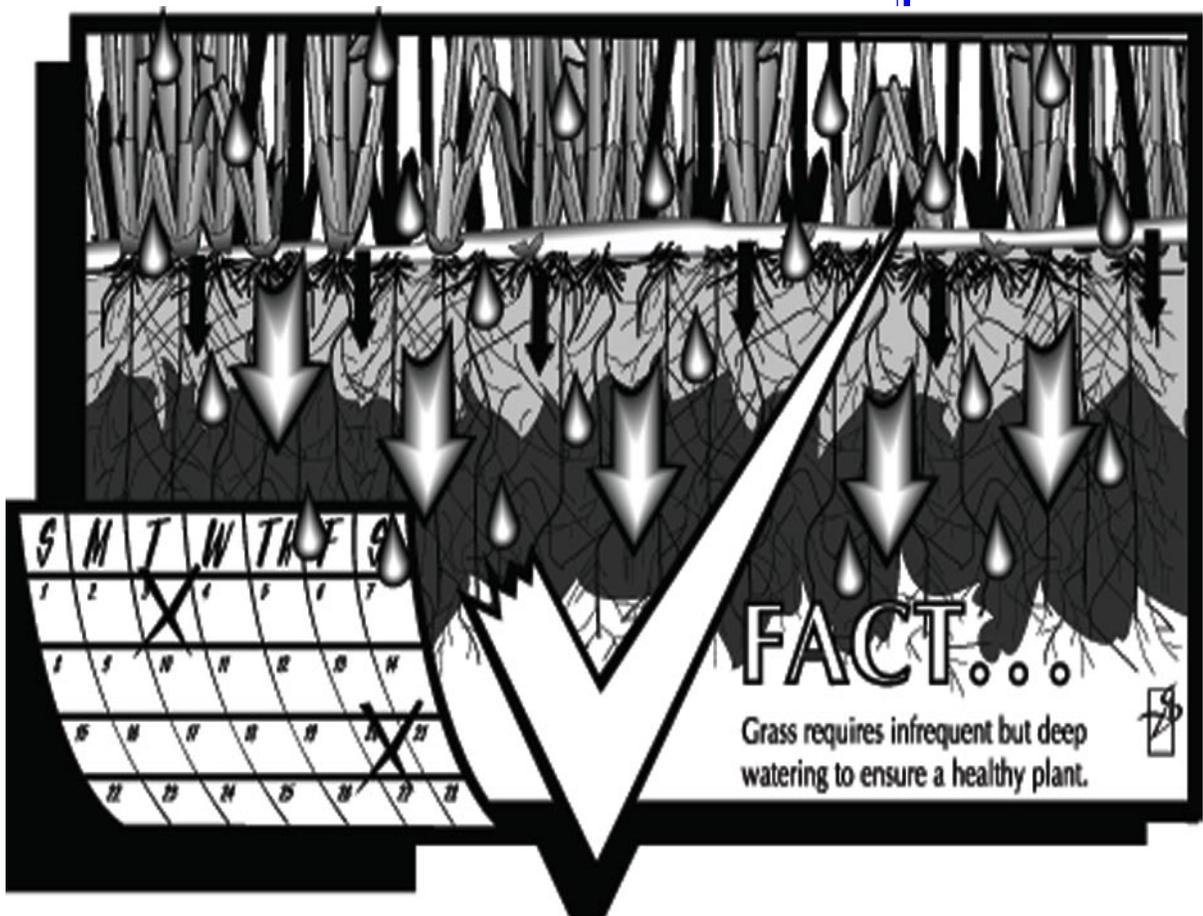
plantings are more likely to stay wet, making them more vulnerable to disease.

## Reduce Pests by Controlling Thatch

Microorganisms and earthworms help decompose dead organic materials in and on the soil. This activity releases nutrients into the soil to be taken up by grass roots. Grass clippings decompose easily in this manner; they do not contribute to thatch.

The thatch layer in lawns is composed of dead and living shoots, stems, and roots of grass plants. These parts of grass plants resist decay and accumulate on the soil surface, forming thatch. A small amount of thatch is desirable; however, the accumulation of more than 1/2 inch of thatch limits water and air movement, reduces the effects of fertilizer and pesticide applications, promotes shallow rooting, and increases disease and insect damage. Excessive thatch buildup can be managed with proper applications of moderate amounts of fertilizer and water.

Removal of excessive thatch is difficult and expensive. It may require the use of aerification equipment or, at worst, the physical removal of the sod (including the thatch layer) and the reestablishment of a new lawn. Power rakes (dethatching machines) are effective in minimizing thatch, but they are not effective in removing excessive layers of thatch.



## **Renovate the Lawn to Correct Major Problems**

Homeowners often desire a simple solution to a major problem. A lawn that has been seriously damaged by insects or disease cannot be repaired with pesticides. These chemical compounds are formulated to *manage* pests; but once serious damage occurs, *pesticides can't bring dead grass back to life.*

Pesticides are useless on neglected or poorly managed lawns. When more than 5 percent of a lawn consists of weeds and dead grass, complete renovation is required. The homeowner may choose to do the renovation with the aid of information available from the local Cooperative Extension Service; in some cases, however, it may be better to employ a professional firm to renovate the lawn. In either case, lawn renovation is a major undertaking that has to be done properly and completely. The optimum time for renovating a lawn is late summer. Preparation should begin in August so seed can be planted in the fall according to recommendations for the geographical area.

## **Use Pesticides Only for Major Pest Outbreaks**

Good cultural practices result in healthy grass that can withstand some damage from insects, weeds, and diseases. Regular inspections will help detect early insect infestations, the presence of weeds, and symptoms of disease. Pest populations and the damage they cause should be monitored closely. If it is determined that the situation does require a pesticide application, it is essential that the person making the application know what they are doing.

First, the pest must be positively identified, followed by the selection of a pesticide product suitable for both the pest and the site to be treated. The pesticide label must be read carefully and followed explicitly. If any part of the label is unclear to the applicator, it is important that a professional be consulted for clarification. Children and pets must be kept well away from the area during treatment; and in the case of lawn spray applications they must be kept away until the pesticide has dried completely. When granules are applied to lawns, they should be watered thoroughly into the soil and the grass allowed to dry. Some pesticide labels state specific periods of time during which people must stay off a treated lawn. Consideration of neighbors should be exhibited by posting 'keep off' signs which indicate that a pesticide application has been made to the area.

Grubs hatch during mid July in southern Indiana, late July in the central part of the state, and early August in the north. Egg hatch is the optimal time for

grub control applications because newly hatched grubs are very susceptible to insecticides and because only minimal turf damage will have occurred. Waiting until severe damage is apparent before treating means killing larger, hardier grubs in an already stressed turf.

On the other hand, not all turfgrass will be infested with grubs every year. Responsible use of chemicals dictates that they be used only when and where needed. So, how does one know if treatment is required, before it is too late? The answer lies in monitoring. To monitor for grubs, cut a small section of turf at several locations during peak egg hatch (use a knife for this sampling). Search through the soil just below the thatch for tiny white grubs. Grubs in low concentrations (4 or less per square foot of turf) seldom cause any damage and do not merit concern; slightly increased irrigation will rejuvenate the turf with no apparent or lasting damage. Larger numbers (8 or more grubs per square foot) require immediate treatment to prevent damage. Concentrations of 4–8 per square foot call for individual judgment. Points to consider are (1) whether slight grub damage in the affected area would be tolerable and (2) whether more irrigation to the area might negate the effects of minimal root pruning by grubs; if the answer to the latter is yes, the homeowner might elect to forego the cost and energy of an insecticide application.

However, if treatment is required, it is important to irrigate, apply the product correctly (calibrate equipment properly), and follow all label directions during application. Regardless of whether or not the decision is to treat, the area should be monitored again the following week as well as throughout late summer and fall.

Most lawn diseases go essentially unnoticed in the early stages; and once they have advanced to the point of recognition it is very unlikely that control can be accomplished, even with pesticides. Although small damaged areas sometimes respond to good maintenance practices such as fertilization and watering, complete renovation usually is a wiser choice for larger areas.

The best control for lawn weeds is to mow and fertilize appropriately. A dense lawn, mowed as needed and at the proper height, will prevent many annual weeds from becoming a problem. When a weed does create a problem, a positive identification becomes the first step in achieving control. Then, if chemical control is determined to be the best approach, comes product selection, followed by application according to label directions. It should be noted that some perennials are difficult or impossible to control; in those cases, a licensed professional lawn care company may need to be employed.

## **A STRATEGY FOR PEST CONTROL IN HOME GARDENS**

Home vegetable and fruit gardening is a popular outdoor recreational activity in the United States. The gardener gains satisfaction in growing food crops at home. However, insects, weeds, and diseases can become a problem. The best pest management plan for home gardens is prevention. The following pest prevention methods are recommended.

### **Plant Disease-Resistant Cultivars**

Controlling infectious diseases is difficult; therefore, emphasis should be placed on prevention. The first step is to determine what diseases are most common on the crop to be grown, where it will be grown; then, if available, choose cultivars known to be resistant to those diseases. But if disease-resistant cultivars are unavailable (or not chosen), preventative pesticide applications should be considered as a precautionary measure.

If a fungal disease is identified, a fungicide registered for controlling it on the host plant must be applied on a regular basis (usually every 7–14 days). Very thorough coverage of the leaf and stem surfaces of the entire planting is necessary since most fungicides available to homeowners are not curative, but preventative; i.e., they must be applied to healthy leaves to *prevent* invasion by the fungus.

### **Remove Plant Residues**

Since many pests can overwinter in dead plant debris, it is important to remove vegetation as soon as its produce is harvested, thereby eliminating possible harborage. Removing expended plant material will render the garden less attractive to insects overall, thus lessening the potential for infestation of plants not yet harvested. Weeds should be removed before they have a chance to produce seed; if the plant tissue is healthy, it may be composted. In orchard situations, fallen fruit and leaves should be collected and removed to ensure that they do not host pest populations destined to become a problem the following year.

### **Purchase Healthy Plants**

Plants should be inspected carefully, before purchase, to be sure they are free of insects and disease. Discoloration and stunting are two signs of pest damage.

## Improve the Soil

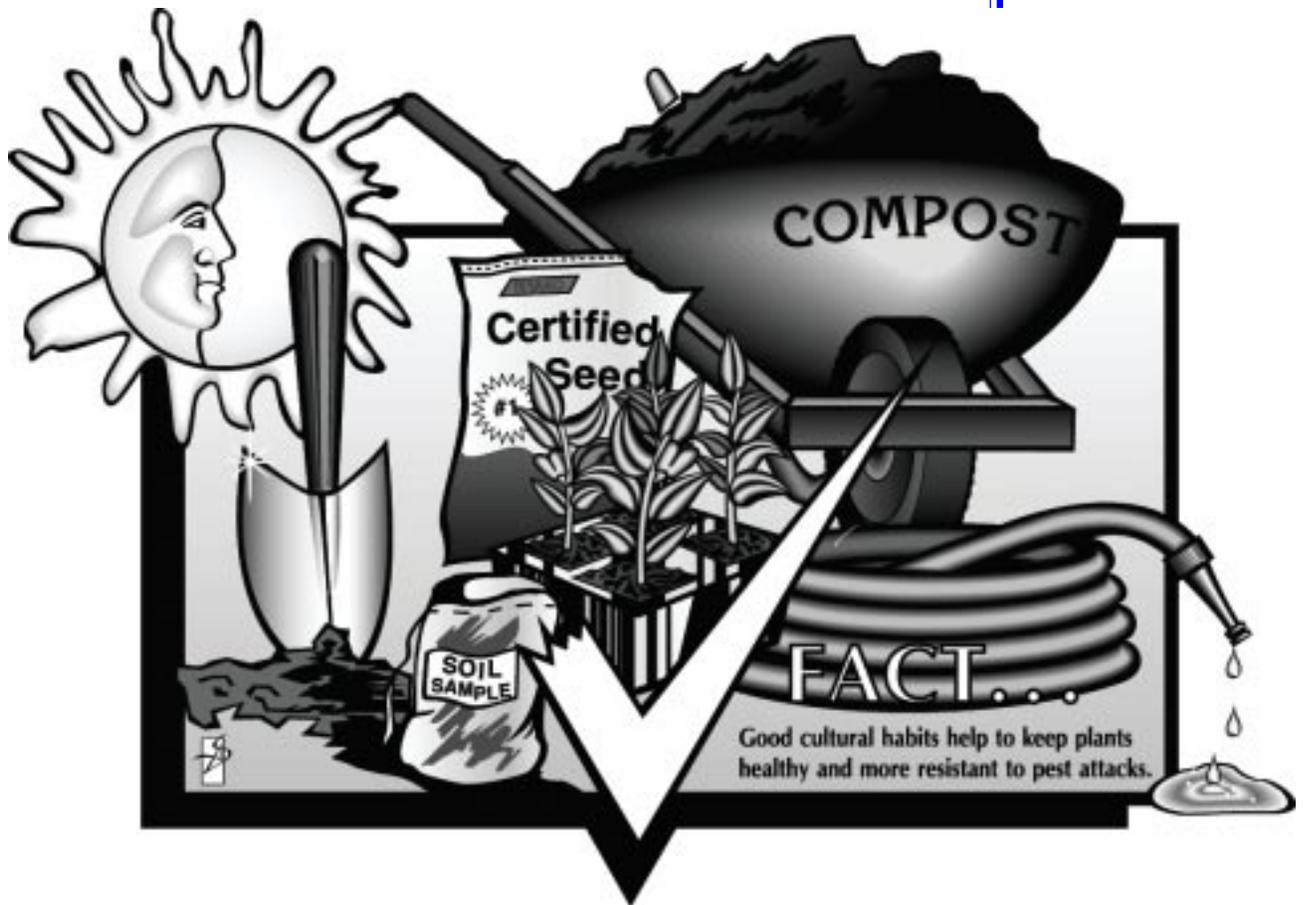
Organic matter such as compost should be mixed into the soil at the beginning of each gardening season unless the soil is heavy clay that holds too much water for long periods of time. Garden soil should be tested at least every three years and amended by fertilizing as required. A loose, fertile soil promotes healthy plant growth, and healthy plants can out-compete pests, yielding more high quality produce.

## Use Proper Gardening Practices

Optimum growing conditions yield plants with fewer pest problems. Planting, spacing, watering, fertilizing, and controlling weeds according to prescribed guidelines for the plants grown in the area grown will result in gardening success.

## Mulch to Prevent Weeds

A thin layer of grass clippings (not recently treated with herbicides), leaves, straw, sawdust, wood chips, or compost can be spread around plants to control weeds. As these organic materials decay, they add nutrients to the soil. Mulch helps retain soil moisture and moderates soil temperatures in the summer.



Black plastic can be used as a ground cover to conserve moisture and control weeds. It will warm the soil in the spring but may retain too much heat for some plants in summer. Plastic mulches should be used only with plantings of annual vegetables and flowers; in landscape beds, it can prevent water and air from reaching the roots of trees and shrubs. It also may encourage shallow rooting, leaving the plants more susceptible to cold injury.

## **Rotate Crops and Diversify Plantings**

Vegetable crops should be rotated to different locations in the garden each year in an effort to reduce the potential for buildup of pest problems in the soil. But if a serious problem does occur, the crop involved should not be replanted in the questionable area for at least five years.

## **Encourage Beneficial Insects**

Less than one percent of all known insect species are considered pests. It is important to know the difference between beneficial and harmful insects. Beneficial insects include ladybugs, bees, green lacewings, praying mantises, dragonflies, and wasps. Spiders are examples of beneficial arthropods.

## **Scout for Pests and Symptoms of Pest Damage**

Plants should be inspected for pests several times each week. Insects feeding on plants present the gardener with two choices: Tolerate the damage, or try to control it. Control methods that don't require pesticides include hand removal of the insects, early harvest, or tolerance of small amounts of damage. For example, corn earworm damage to the tips of sweet corn ears can be cut off; the outer leaves of cabbage damaged by insects can be removed; superficial blemishes on the skin of an apple can be peeled off.

An insecticide application may be necessary when plants are in danger of being severely damaged or destroyed. But before using a pesticide the home gardener should understand that

- The pesticide label is a legal document;
- It is the user's responsibility to read and follow the label explicitly;
- Pesticides must be applied only at rates specified on the label (more is not better);
- Pesticide labels may stipulate waiting periods—called preharvest intervals—which must elapse between application and harvest of the crop for human consumption; fruits and vegetables always should be washed thoroughly before eating.

## **A STRATEGY FOR PEST CONTROL ON LANDSCAPE PLANTS**

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The diversity of plant materials in the residential landscape translates to a wide range of potential pest problems. Keeping plants healthy can prevent many of them. Plants that are stressed from undesirable cultural or site conditions grow poorly and become prime targets for pests. For example, a landscape plant is more likely to have spider mite problems when it is planted in a hot, dry area. Likewise, plants that have been damaged by a lawn mower are more likely to have borer problems than undamaged, healthy ones. The best way to discourage plant pest problems is to fulfill their cultural requirements.

### **Select Recommended Plants**

It is wise to choose proven performers—plants known to do well in the area intended for planting. Those known to have a history of pest problems should be avoided. Resistant plant species and cultivars should be used when available. Clavey's dwarf honeysuckle, for example, is resistant to an aphid that seriously damages other honeysuckles; and a scab resistant crab apple cultivar is a wise choice over a susceptible species. When a pest becomes a recurring problem, consider replacing the plant with a non-susceptible cultivar.

### **Design with Diversity**

Increasing plant diversity makes it more difficult for pests to spread between plants, so it is recommended that a wide variety of plants be included in a landscape. For example, there are four pests—the mimosa webworm, the honey locust spider mite, the locust plant bug, and the leafhopper—that can cause serious damage to honey locust stands; merely planting other tree species among the honey locusts will reduce the damage potential.

### **Inspect Plant Materials at the Source**

Plants should be inspected for pests before they are purchased, no matter where they are purchased. New (infested) plants can introduce pest problems to the landscape.

### **Provide a Properly Prepared Site**

Site selection is critical: The site *must* be compatible with the plants' requirements. Things to consider are exposure to sunlight, drainage, soil pH, and nutrition.

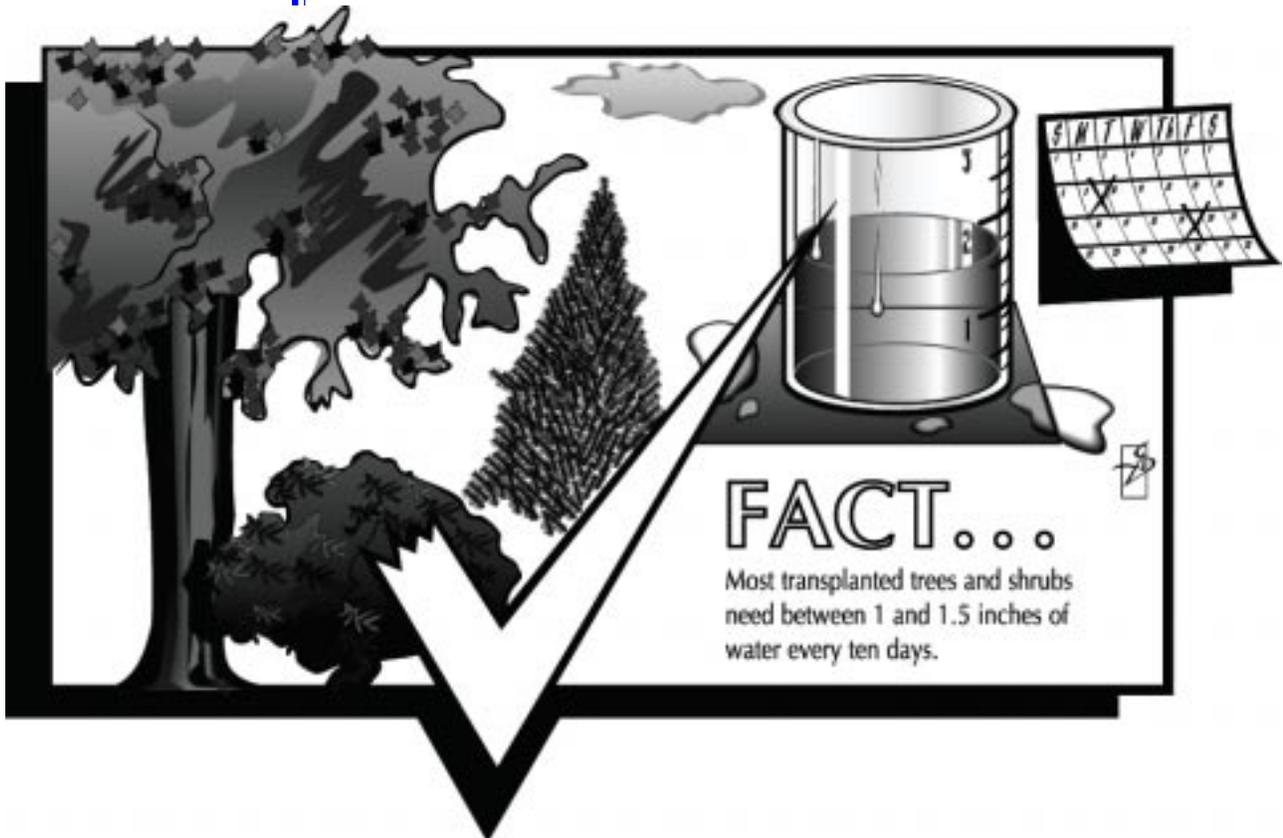
The soil must be prepared carefully, using soil amendments as required for healthy growth. Lime should not be added unless a reliable soil test has indicated the need.

### **Plant at the Proper Depth**

Planting at the proper depth may prevent damage that could make plants more attractive to pests. The hole for planting should be dug just deep enough to accommodate the root ball of the plant. Loosening soil under the root ball will result in settling and subsequent injury to the roots.

### **Provide Proper Fertilization and Irrigation**

Plants need proper and adequate nourishment for healthy growth, and deciding what fertilizer to use and how much to apply is crucial to successful landscaping. Soil tests are helpful in determining the needs of the soil itself, but it is equally important to address the nutritional needs of each plant, as well. Transplanted trees, shrubs, and other landscape plants may benefit from a small application of fertilizer at planting, but care should be taken not to overdo it. Established plants usually receive adequate nutrients when the lawn is fertilized.



## **Apply Mulch Around Landscape Plants**

Mulch will conserve moisture and protect plant roots from extreme temperatures; and it can prevent bark injury from lawn mowers and string trimmers. It should be applied 2–4 inches deep and kept at least 2 inches away from tree trunks and the bases of shrubs.

## **Know When to Prune**

There are good and bad times to prune. Caution should be taken to ensure that the pruning process does not leave trees and shrubs more vulnerable to damage from other sources. For example, oak wilt, a serious disease of red and white oaks, is spread by a fungus which beetles carry from infected trees to fresh wounds on others; therefore, oaks should not be pruned in spring and early summer when insect activity is high.

Most plants can be pruned in late winter or early spring, but trees and plants that flower in the spring should be pruned *after* the blooms fade.

## **Manage Noninfectious Problems Promptly**

Problems transmitted from one plant to another by living organisms are called infectious; those that result from factors other than living organisms are called noninfectious. Many landscape plant problems are caused by noninfectious factors.

Plant problems resulting from soil compaction and mechanical damage to the bark often are caused by people, not pests. Environmental factors such as extreme cold or hot temperatures, drought, flooding, and lightning also can cause problems, many of which can be diminished by implementing proper cultural practices. Watering during periods of drought, improving soil drainage, and fertilizing appropriately can minimize injury from noninfectious factors. Pesticides cannot prevent damage caused by noninfectious factors.

## **Inspect for and Monitor Insects and Diseases**

There are two things to remember relative to monitoring landscape plants for pests: Regular inspections are helpful in preventing serious pest damage; and early season infestations can be more damaging than those that show up later.

## **Physically Remove the Pest**

Physical removal and destruction is one effective way to manage many pest problems. The eastern tent

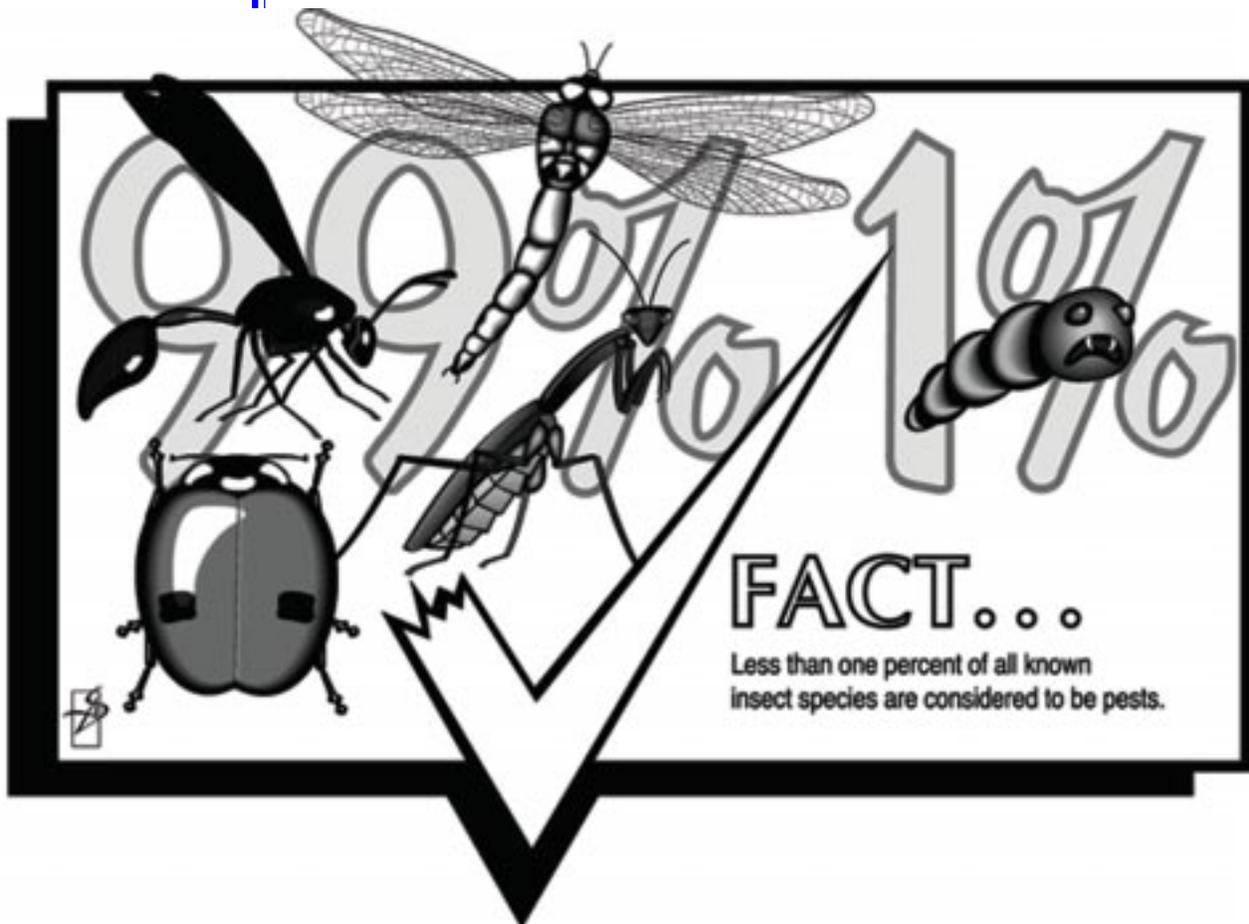
caterpillar is an example. This insect problem starts in a small group of eggs attached to a twig in a tree. After the eggs hatch, the caterpillars feed on leaves at night. During the day they hide from birds in webbed tents built in the forks of tree limbs. Much of their damage can be avoided by removing and destroying these tents when the caterpillars are still small and inside. Pruning out pest-infested branches can be an effective way to avoid further damage on vigorously growing plants. Oystershell scale on red twig dogwood can be controlled in this manner.

### **Identify the Location of Injury**

When pest damage is identified, it is important to determine which part of the plant is being affected. This will help in deciding whether or not a pesticide is needed; pest damage to plant leaves usually is less serious than damage to trunks, stems, or roots, so pesticides might be ruled out if only the leaves are involved.

### **Use Biological Management Methods**

Biological control involves the use of natural enemies to reduce or prevent pest damage. Not all



insects, mites, and diseases are harmful to plants; many, in fact, are predators, parasites, or pathogens. It is important to distinguish between pests and their natural enemies. When the natural enemies are present, they should be given time to become established and control the pest.

Predators attack, kill, and eat multiple numbers of pests. Parasites lay an egg in or on a pest; and when the egg hatches, the new parasite consumes and usually kills the pest as it matures. Pathogens are free-living microscopic organisms (bacteria, fungi, viruses, etc.) that invade the pest and cause a disease that weakens or kills it.

### **Use Pesticides as a Last Resort**

Pesticides should be used only when the pest threatens to cause serious damage to the host. When more than one pesticide is available to control the pest on the specified site, the one that is least harmful to natural enemies should be selected.

## **A STRATEGY FOR PEST CONTROL IN THE HOME**

Practical methods are available for managing pest infestations in the home, but the homeowner should be aware that a one-time pesticide application usually will not provide long-term control. However, thorough, one-time applications of baits for roaches and rodents can and have solved pest problems. The following methodology applies to many situations and should be considered in developing pest management strategies for use in the home environment.

### **Identify the Pest**

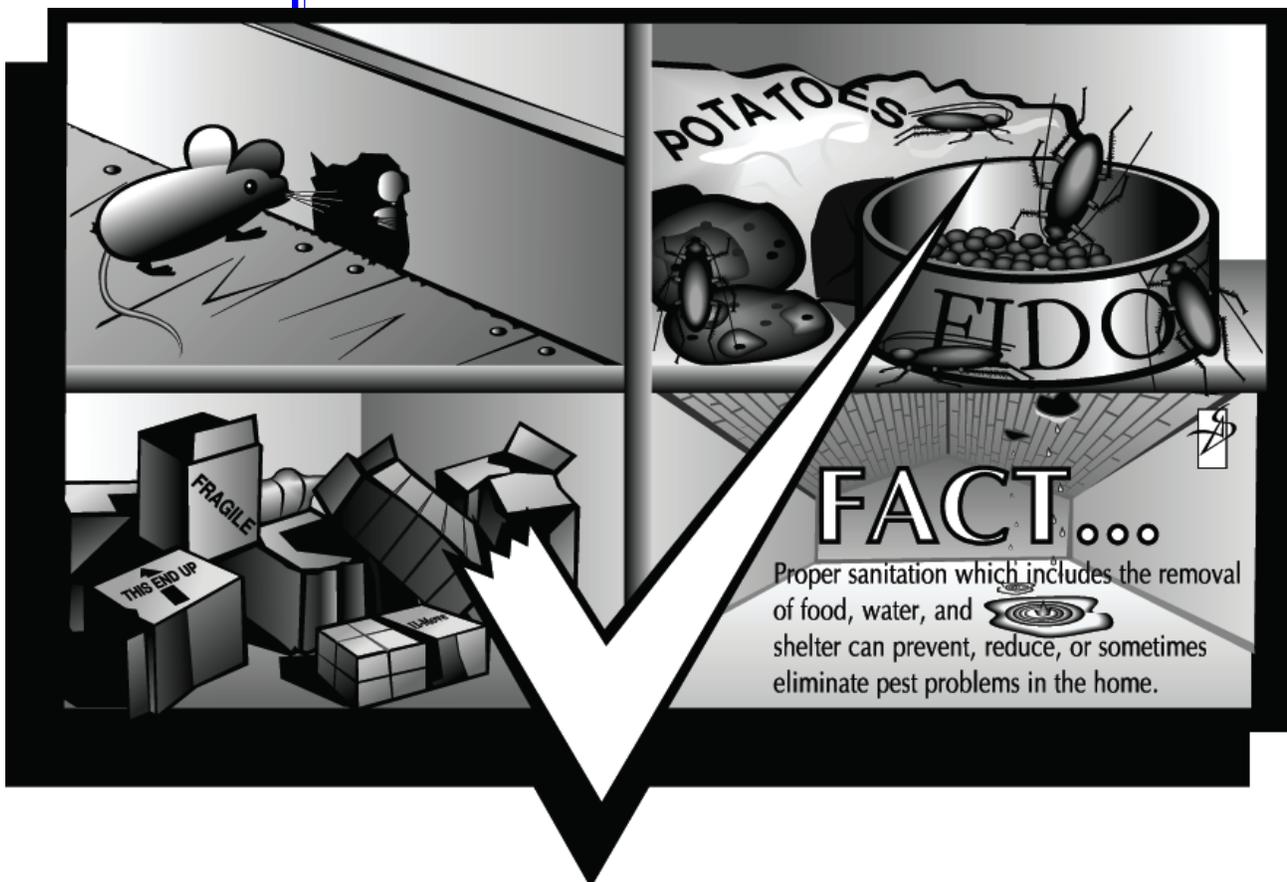
Proper and complete identification of the pest is critical. For example, identifying an insect pest as a cockroach is not sufficient. German, American, Oriental, brown-banded, and brown-banded cockroaches have very separate and distinct biologies and behavior patterns; and a thorough understanding of those characteristics is essential in the development of a sound management strategy. It is from such information that one can determine how, when, and where to inspect for the pest. County Extension and Purdue Plant and Pest Diagnostic Laboratory personnel are available to assist Indiana homeowners with pest identification. They can provide information on the pest and how to manage it—and they also can advise the homeowner as to whether or not a pest control professional should be consulted.

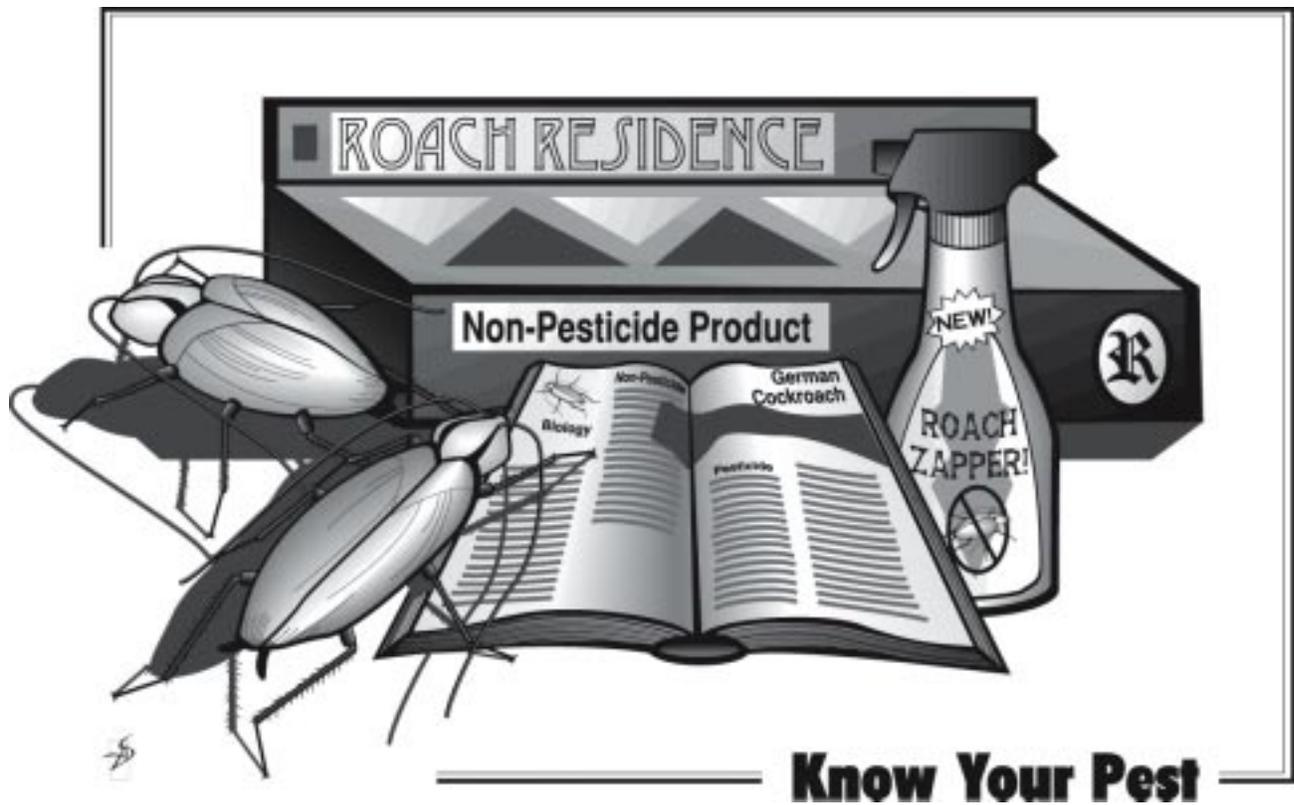
## Inspect the Home for Pests

*Routine and detailed* visual inspections are critical to long-term pest management. The inspection should identify conditions favorable for pest infestations. Some insects (e.g., cockroaches, silverfish, carpenter ants) and rodents are active at night; therefore, nocturnal inspections conducted perhaps an hour or two after dark are important in determining where they are nesting, feeding, traveling, etc. The exercise should occur quietly and with the aid of a powerful flashlight, covering all areas that might possibly provide the pest with food, water, warmth, or shelter. During warm weather, the inspection should be extended to the outdoor perimeter of the structure.

## Use Good Sanitation Practices

Elimination of a pest's food, water, and shelter sources will almost certainly reduce the infestation and may even eliminate it altogether. Good sanitation practices for the home include proper management of household garbage; the avoidance of long term storage of food products and clutter in garages, attics, and basements; and regular cleaning around appliances and in areas frequented by pets.





## Know Your Pest

### Pest-Proof the Home

The best method of managing pests in the home is to exclude them—in effect, to ‘pest proof’ the house: Caulk cracks and crevices; repair a leaky roof; add screens; seal thresholds and chimneys. All openings larger than 1/4 inch must be closed to exclude mice; smaller openings and cracks must be sealed to exclude insects. Many ‘how-to’ home repair and improvement books offer tips on pest-proofing the home.

### Use Traps for Minor Problems

Although traps cannot be used to control major, established pest infestations, there are many types of traps that can be used for small infestations of certain pests. Examples include snap traps for mice; sticky boards for cockroaches and mice; yellow jacket sugar traps; and sticky fly strips. The key to success with traps is placement. Since pests will not travel out of their way to locate traps, it is important to determine where the pest is most active, or where the pest population is concentrated. A sufficient number of traps—for mice, 3 or 4 per individual—should be placed in those areas. It is *always* advisable to use more than one trap.

## Use Pesticides Properly

Understanding pest biology and behavior can reduce unnecessary or excessive use of pesticides in the home. Pesticides should be applied only as spot treatments in pest-populated areas identified during an inspection. Only pesticides labeled for indoor use should be used inside the home. It is important to realize that one application of a pesticide inside the house may not provide long-term control. Multipurpose pesticides labeled for outdoor use should not be applied indoors unless the label specifically permits it. Routine application of pesticides on baseboards and shelves, and in attics is not necessary or effective for most pests.

Pesticide treatments around the perimeter of a building can be effective for some pest problems. In many cases, pest management professionals are better trained and equipped than the homeowner to make perimeter treatments. Perimeter treatments should be used only when needed, not as a cure-all for keeping insects out of the home. It is more important to identify and correct food, water, and shelter conditions that favor pests, both inside and out.

### Eliminating Breeding Places for Mosquitoes

The most effective method of mosquito control around the home is to prevent or eliminate breeding sites:

1. Destroy or dispose of tin cans, tires, and any other object in which water might accumulate.
2. Inspect water in flower plots and plant containers on a weekly basis; if mosquito larvae are detected, change the water.
3. Change the water in bird baths and wading pools at least once or twice a week; drain wading pools not in use.
4. Stock garden and lily ponds with top-feeding minnows.
5. Keep rain gutters unclogged and flat roofs dry.
6. Drain and fill stagnant pools, puddles, and ditches.
7. Keep margins of small ponds clear of vegetation.
8. Place tight covers over cisterns, cesspools, septic tanks, fire barrels, rain barrels, and tubs where water is stored.
9. Fill all tree holes with sand or mortar, or drain them.
10. Remove tree stumps that may hold water.

Source: Mosquitoes In and Around the Home (E-26). Purdue University.

## **Purdue Resources**

### ***Telephone***

Telephone numbers for county offices of the Purdue University Cooperative Extension Service may be acquired by calling (888) 398-4636.

### ***Publications***

Publications on pest control in lawn, landscape plant, fruit and vegetable, and residential situations may be obtained through county offices of the Purdue University Cooperative Extension Service. County Extension Educators have access to a current list of publications available and are eager to assist homeowners in acquiring information pertinent to their specific pest control problems.

### ***Newsletter***

*Down the Garden Path*, a newsletter that presents homeowners with timely information on many aspects of insect and disease control and other horticultural topics, is available through the Plant and Pest Diagnostic Laboratory, Purdue University, 915 W State Street, West Lafayette, IN 47907-2054. Those interested in subscribing may call (765) 494-7071. Questions from subscribers, with appropriate specialists' replies, are featured in each issue.

### ***Special Programs***

- The Indiana Master Gardener Volunteer Educator Program, conducted through participating county Extension offices, provides an intensive education in horticultural principles to those with an interest in helping teach gardening information. Interns are schooled in subjects such as plant and soil science, plant problem diagnosis, pesticide safety, and vegetable, flower, fruit, and landscape gardening. After completing their training, interns must volunteer one hour of community education for each hour of training received.

Interested parties should write the Master Gardener State Coordinator, 625 Agriculture Mall Dr., Purdue University, West Lafayette, IN 47907, or call (765) 494-1311. Information can also be obtained through county Cooperative Extension Service Educators.

- Purdue University's Plant & Pest Diagnostic Laboratory staff—experts in the areas of entomology, botany and plant pathology, horticulture, forestry and natural resources, and agronomy—are available to assist the homeowner in identifying pest problems and for advice on appropriate remedial procedures. Write

the Director, Plant and Pest Diagnostic Laboratory, Purdue University, 915 W. State Street, West Lafayette, IN 47907-2054, or phone (765) 494-7071. Form PPDL-3 is available through county Extension offices. The form must be properly and completely filled out and must accompany all samples submitted to the laboratory. Directions for completion are found on the back of the form.

### **Acknowledgments**

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### **COMPANION PUBLICATION**

#### ***Pesticides in the Home, Lawn, and Garden (PPP-29)***

*Pesticides in the Home, Lawn, and Garden is a companion to PPP-34. It addresses information all homeowners should know about using over-the-counter pesticides. Features include pesticide safety, pesticide labels, definitions of words commonly found on pesticide labels, and pesticide disposal.*

*PPP-29 and PPP-34 are available through the Purdue University Media Distribution Center. Call (888) 398-4636.*

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