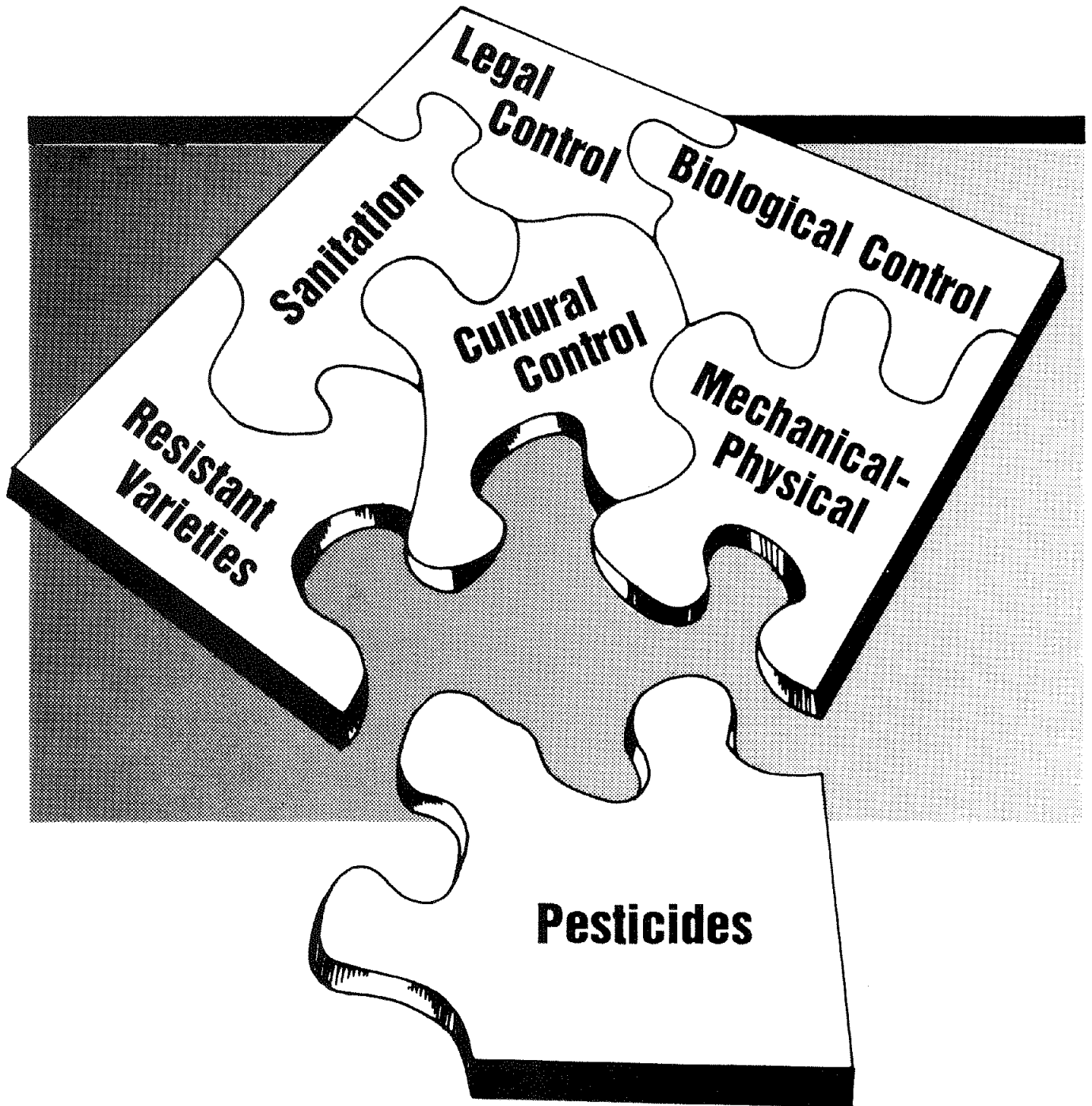
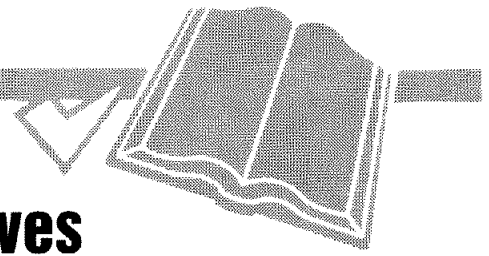
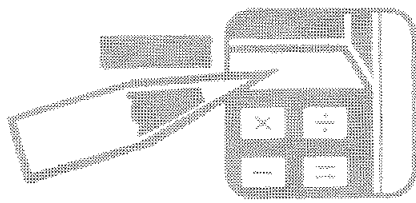


Principles of Pest Control





Learning Objectives

After you complete your study of this unit, you should be able to:

- Explain why identification of the pest is the first step in developing an effective pest control strategy.
- Explain the differences between continuous pests, sporadic pests, and potential pests.
- Explain what is meant by prevention, suppression, and eradication of pests.
- Describe “thresholds” and why they are an important consideration in developing a pest control strategy.
- Describe “monitoring” as it relates to pest control and explain why it is important to pest control strategy.
- Define “integrated pest management” and list several possible control tactics that may be used in an IPM strategy.
- Name factors that can cause pesticide applications to fail to control pests.
- Name ways to help avoid the development of pest resistance to pesticides.

Terms To Know

Host — A plant or animal on or in which a pest lives.

Juvenile hormones — Natural insect chemicals that keep the earlier stages of an insect from changing into the normal adult form.

Labeling — The pesticide product label and other accompanying materials that contain directions that pesticide users are legally required to follow.

Mycoplasmas — The smallest known living organisms that can reproduce and exist apart from other living organisms. They obtain their food from plants.

Nematodes — Small, usually microscopic, eel-like roundworms.

Nontarget organism — Any plant or animal other than the pest that is being controlled.

Parasite — An organism living on, in, or with another living organism for the purpose of obtaining food.

Pathogen — An organism that causes disease in other organisms.

Pheromones — Chemicals emitted by an organism to influence the behavior of other organisms of the same species.

Predator — An organism that attacks, kills, and feeds on other organisms.

Scouting — Regularly searching for, identifying, and assessing numbers of pests and the damage they are causing.

A pest is anything that:

- competes with humans, domestic animals, or desirable plants for food or water,
- injures humans, animals, desirable plants, structures, or possessions,
- spreads disease to humans, domestic animals, wildlife, or desirable plants,
- annoys humans or domestic animals.

Types of Pests

Types of pests include:

- insects, such as roaches, termites, mosquitoes, aphids, beetles, fleas, and caterpillars,
- insect-like organisms, such as mites, ticks, and spiders,
- microbial organisms, such as bacteria, fungi, nematodes, viruses, and mycoplasmas,
- weeds, which are any plants growing where they are not wanted,
- mollusks, such as snails, slugs, and shipworms, and
- vertebrates, such as rats, mice, other rodents, birds, fish, and snakes.

Most organisms are not pests. A species may be a pest in some situations and not in others. An organism should not be considered



a pest until it is proven to be one.

Categories of pests include:

- **continuous** pests that are nearly always present and require regular control.
- **sporadic, migratory, or cyclical** pests that require control occasionally or intermittently.
- **potential** pests that do not require control under normal conditions, but may require control in certain circumstances.

Pest Identification

Accurate identification is the first step in an effective pest management program. Never attempt a pest control program until you are sure of what the pest is. The more you know about the pest and the factors that influence its development and spread, the easier, more cost-effective, and more successful your pest control

will be. Correct identification of a pest allows you to determine basic information about it, including its life cycle and the time that it is most susceptible to being controlled.

As a certified applicator, you must be familiar with the pests you are likely to encounter in the type of work in your certification category. To be able to identify and control pests, you need to know:

- the physical features of the pests likely to be encountered,
- characteristics of the damage they cause,
- their development and biology,
- whether they are continuous, sporadic, or potential pests, and
- what your control goal is.

If you need help in identifying a pest, contact your commodity or industry organization, Cooperative

Extension agent, or State land-grant university.

Pest Control

Any time you are considering whether pest control is necessary, remember:

Control a pest only when it is causing or is expected to cause more harm than is reasonable to accept.

Use a control strategy that will reduce the pest numbers to an acceptable level.

Cause as little harm as possible to everything except the pest.

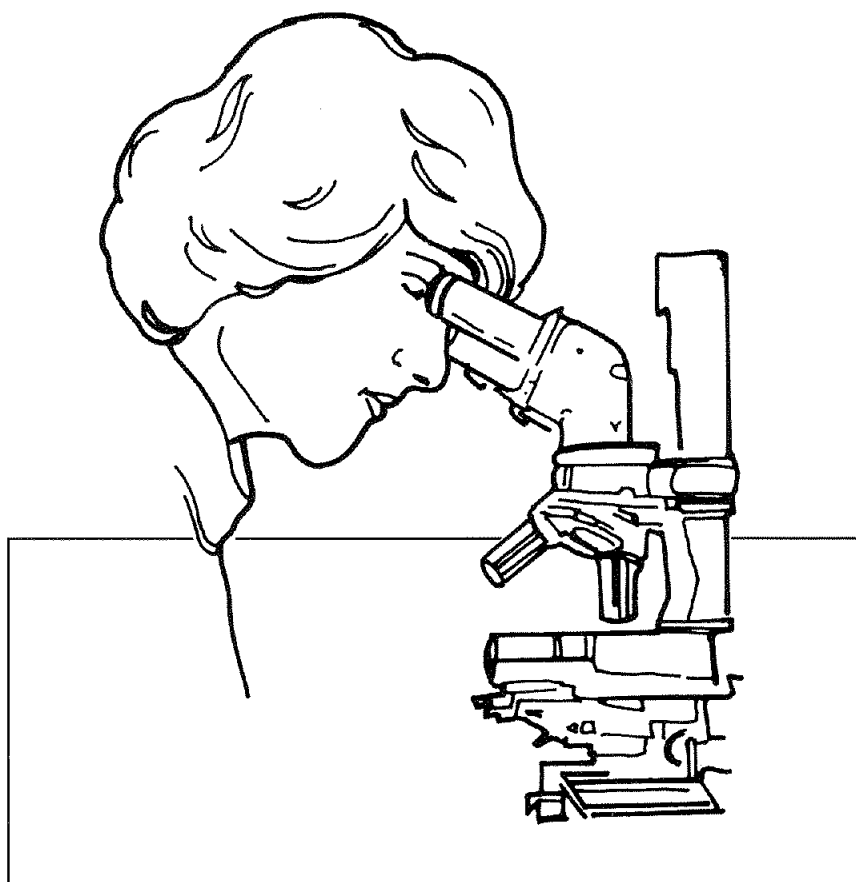
Even though a pest is present, it may not do very much harm. It could cost more to control the pest than would be lost because of the pest's damage.

Pest Control Goals

Whenever you try to control a pest, you will want to achieve one of these three goals, or some combination of them:

- prevention — keeping a pest from becoming a problem,
- suppression — reducing pest numbers or damage to an acceptable level, and
- eradication — destroying an entire pest population.

Prevention may be a goal when the pest's presence or abundance can be predicted in advance. Continuous pests, by definition, are usually very predictable. Sporadic and potential pests may be predictable if you know the circumstances or conditions that will favor their presence as pests. For example, some plant diseases occur only under certain environmental conditions. If such conditions are present, you can take steps to prevent the plant disease organisms from harming the desirable plants.



Suppression is a common goal in many pest situations. The intent is to reduce the number of pests to a level where the harm they are causing is acceptable. Once a pest's presence is detected and the decision is made that control is necessary, suppression and prevention often are joint goals. The right combination of control measures can often suppress the pests already present and prevent them from building up again to a level where they are causing unacceptable harm.

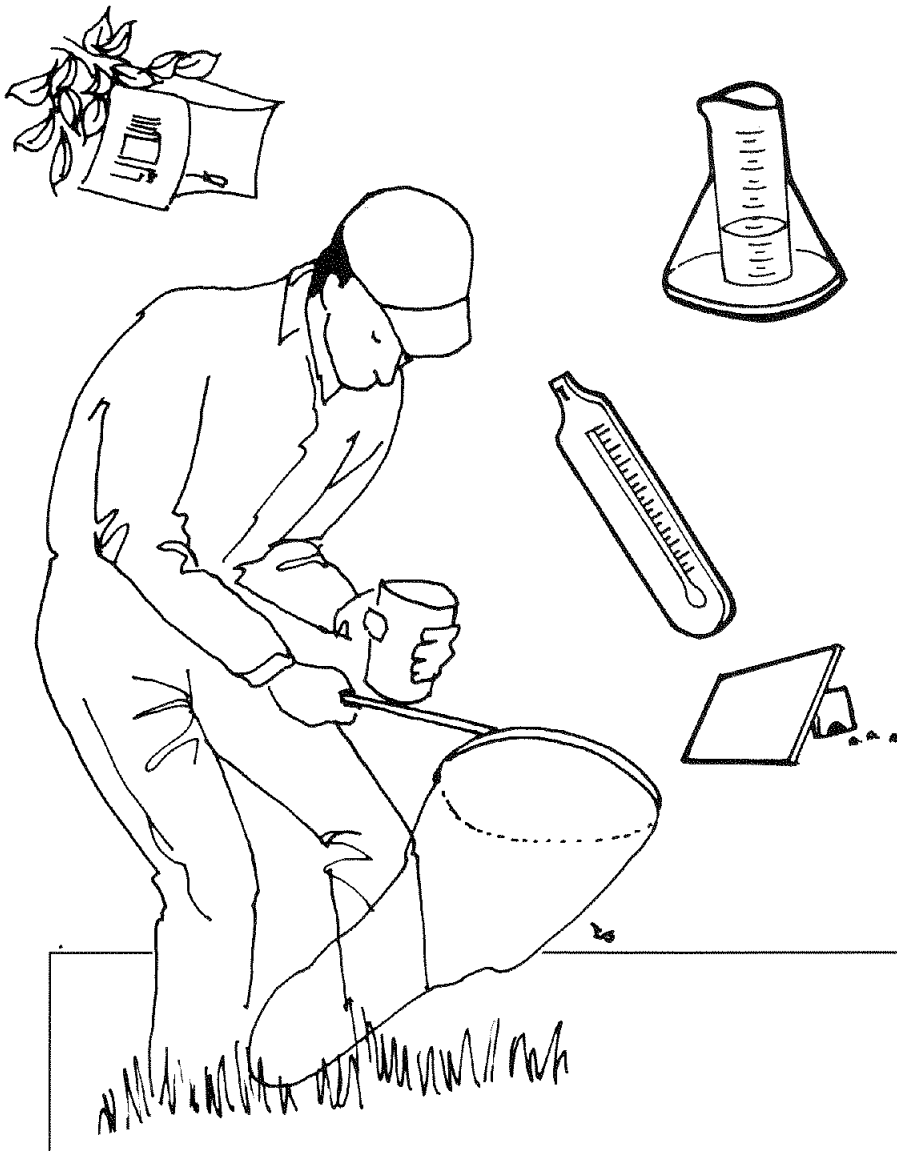
Eradication is a rare goal in outdoor pest situations, because it is difficult to achieve. Usually the goal is prevention and/or suppression. Eradication is occasionally attempted when a foreign pest has been accidentally introduced but is not yet established in an area. Such eradication strategies often

are supported by the Government. Mediterranean fruit fly, gypsy moth, and fire ant control programs are examples.

In indoor areas, eradication is a more common goal. Enclosed environments usually are smaller, less complex, and more easily controlled than outdoor areas. In many enclosed areas, such as dwellings; schools; office buildings; and health care, food processing, and food preparation facilities, certain pests cannot or will not be tolerated.

Threshold Levels

Thresholds are the levels of pest populations at which you should take pest control action if you want to prevent the pests in an area from causing unacceptable injury or harm. Thresholds may be based on esthetic, health, or



economic considerations. These levels, which are known as “action thresholds,” have been determined for many pests.

A threshold often is set at the level where the economic losses caused by pest damage, if the pest population continued to grow, would be greater than the cost of controlling the pests. These types of action thresholds sometimes are called “economic thresholds.”

In some pest control situations, the threshold level is zero: even a single pest in such a situation is unreasonably harmful. For example, the presence of any rodents in food processing facilities forces action. In homes, people generally

take action to control some pests, such as rodents or roaches, even if only one or a few have been seen.

Pest Monitoring

In most pest control situations, the area to be protected should be monitored (checked or scouted) often. Regular monitoring can answer several important questions:

- What kinds of pests are present?
- Are the numbers great enough to warrant control?
- When is the right time to begin control?
- Have the control efforts successfully reduced the number of pests?

Monitoring of insect, insect-like, mollusk, and vertebrate pests usually is done by trapping or by scouting. Monitoring of weed pests usually is done by visual inspection. Monitoring for microbial pests is done by looking for the injury or damage they cause.

Monitoring also can include checking environmental conditions in the area that is being managed. Temperature and moisture levels, especially humidity, are often important clues in predicting when a pest outbreak will occur or will hit threshold levels.

Monitoring is not necessary in situations where a pest is continually present and the threshold is zero. For example, there is zero tolerance for the presence of bacteria in operating rooms and other sterile areas of health care facilities. In these situations, routine pest control measures are taken to prevent pests from entering an area and to eradicate any pests that may be present.

Avoiding Harmful Effects

Pest control involves more than simply identifying a pest and using a control tactic. The treatment site, whether it is an outdoor area or inside a structure, usually contains other living organisms (such as people, animals, and plants) and nonliving surroundings (such as air, water, structures, objects, and surfaces). All of these could be affected by the pest control measures you choose. Unless you consider the possible effects on the entire system within which the pest exists, your pest control effort could cause harm or lead to continued or new pest problems. Rely on your own good judgment and, when pesticides are part of the strategy, on the pesticide labeling.

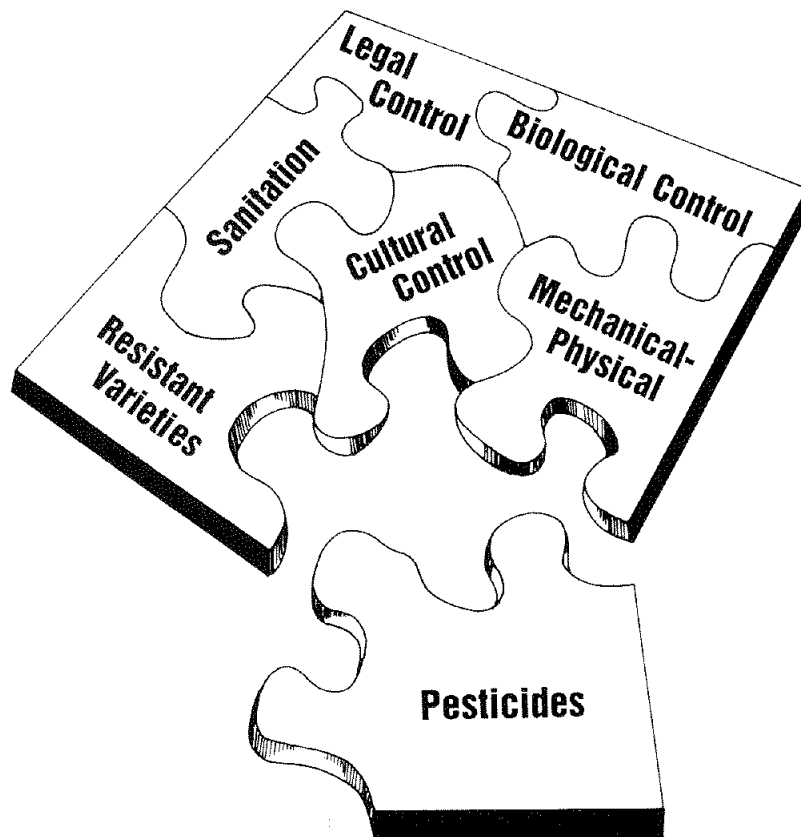
Most treatment sites are disrupted to some degree by pest control strategies. The actions of every type of organism or component sharing the site usually affect the actions and well-being of many others. When the balance is disrupted, certain organisms may be destroyed or reduced in number, and others — sometimes the pests — may dominate.

Integrated Pest Management

Integrated pest management is the combining of appropriate pest control tactics into a single plan (strategy) to reduce pests and their damage to an acceptable level. Using many different tactics to control a pest problem tends to cause the least disruption to the living organisms and nonliving surroundings at the treatment site. Relying only on pesticides for pest control can cause pests to develop resistance to pesticides, can cause outbreaks of other pests, and can harm surfaces or nontarget organisms. With some types of pests, use of pesticides as the only tactic will achieve very poor control.

To solve pest problems, you must:

- identify the pest or pests and determine whether control is warranted for each,
- determine your pest control goal(s),
- know what control tactics are available,
- evaluate the benefits and risks of each tactic or combination of tactics,
- choose a strategy that will be most effective and will cause the least harm to people and the environment,
- use each tactic in the strategy correctly,



- observe local, State, and Federal regulations that apply to the situation.

The strategy you choose will depend on the pest you have identified and the kind and amount of control you need.

Natural Controls

Some natural forces act on all organisms, causing the populations to rise and fall. These natural forces act independently of humans and may either help or hinder pest control. You may not be able to alter the action of natural forces on a pest population, but you should be aware of their influence and take advantage of them whenever possible. Natural forces that affect pest populations include climate, natural enemies, natural barriers,

availability of shelter, and food and water supplies.

Climate

Weather conditions, especially temperature, day length, and humidity, affect pests' activity and their rate of reproduction. Pests may be killed or suppressed by rain, freezing temperatures, drought, or other adverse weather. Climate also affects pests indirectly by influencing the growth and development of their hosts. A population of plant-eating pests is related to growth of its host plants. Unusual weather conditions can change normal patterns so that increased or decreased damage results.



Natural enemies

Birds, reptiles, amphibians, fish, and mammals feed on some pests and help control their numbers. Many predatory and parasitic insect and insect-like species feed on other organisms, some of which are pests. Pathogens often suppress pest populations.

Geographic barriers

Features such as mountains and large bodies of water restrict the spread of many pests. Other features of the landscape can have similar effects.

Food and water supply

Pest populations can thrive only as long as their food and water supply lasts. Once the food source — plant or animal — is exhausted, the pests die or become inactive. The life cycle of many pests depends on the availability of water.

Shelter

The availability of shelter can affect some pest populations. Overwintering sites and places to hide from predators are important to the survival of some pests.

Applied Controls

Unfortunately, natural controls often do not control pests quickly or completely enough to prevent unacceptable injury or damage. Then other control measures must be used. Those available include:

- host resistance,
- biological control,
- cultural control,
- mechanical control,
- sanitation, and
- chemical control.

Host resistance

Some plants, animals, and structures resist pests better than others. Some varieties of plants, wood, and animals are resistant to certain pests. Use of resistant types, when available, helps keep pest populations below harmful levels by making conditions less favorable for the pests.

Host resistance works in three main ways:

- Chemicals in the host repel the pest or prevent the pest from completing its life cycle.
- The host is more vigorous or tolerant than other varieties and thus less likely to be seriously damaged by pest attacks.
- The host has physical characteristics that make it more difficult to attack.

Biological control

Biological control involves the use of natural enemies — parasites, predators, and pathogens. You can supplement this natural control by releasing more of a pest's enemies into the target area or by introducing new enemies that were not in the area before. Biological control usually is not eradication. The degree of control fluctuates. There is a time lag between pest population increase and the corresponding increase in natural controls. But, under proper conditions, sufficient control can be achieved to eliminate the threat to the plant or animal to be protected.

Biological control also includes methods by which the pest is biologically altered, as in the production and release of large numbers of sterile males and the use of pheromones or juvenile hormones.

Pheromones can be useful in monitoring pest populations. Placed in a trap, for example, they can attract the insects in a sample area so that pest numbers can be estimated. Pheromones also can be a control tool. Sometimes a manufactured copy of the pheromone that a female insect uses to attract males can be used to confuse males and prevent mating, resulting in lower numbers of pests. Applying juvenile hormones to an area can reduce pest numbers by keeping some immature pests from becoming normal, reproducing adults.

Cultural control

Cultural practices sometimes are used to reduce the numbers of pests that are attacking cultivated plants. These practices alter the environment, the condition of the host plant, or the behavior of the pest to prevent or suppress an infestation. They disrupt the normal relationship between the pest and the host plant and make the pest less likely to survive, grow, or reproduce. Common cultural practices include rotating crops, cultivating the soil, varying time of planting or harvesting, planting trap crops, adjusting row width, and pruning, thinning, and fertilizing cultivated plants.

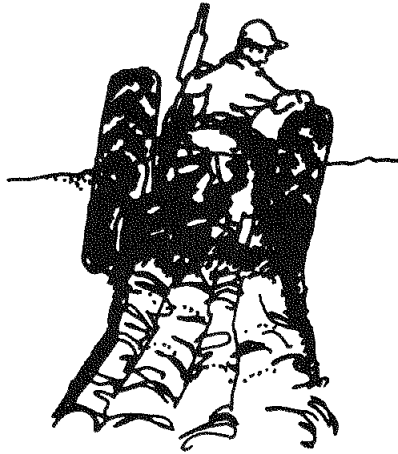
Mechanical (physical) control

Devices, machines, and other methods used to control pests or alter their environment are called mechanical or physical controls. Traps, screens, barriers, fences, nets, radiation, and electricity sometimes can be used to prevent the spread of pests into an area.

Lights, heat, and refrigeration can alter the environment enough to suppress or eradicate some pest populations. Altering the amount of water, including humidity, can control some pests, especially insects and disease agents.

Sanitation

Sanitation practices help to prevent and suppress some pests by removing the pests themselves or their sources of food and shelter. Urban and industrial pests can be reduced by improving



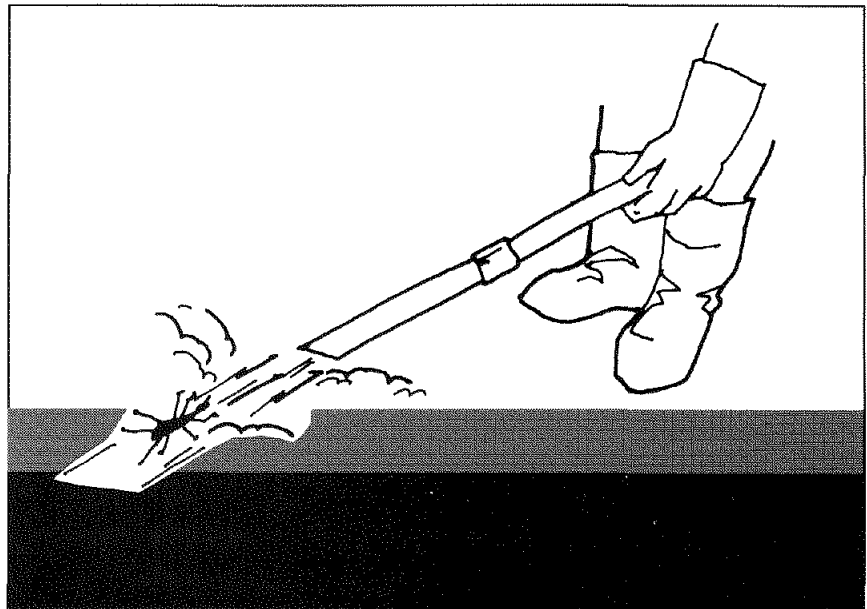
cleanliness, eliminating pest harborage, and increasing the frequency of garbage pickup. Management of pests attacking domestic animals is enhanced by good manure management practices. Carryover of agricultural pests from one planting to the next

can be reduced by removing crop residues.

Other forms of sanitation that help prevent pest spread include using pest-free seeds or transplants and decontaminating equipment, animals, and other possible carriers before allowing them to enter a pest-free area or leave an infested area. The proper design of food-handling areas can reduce access and shelter for many pests.

Chemical control

Pesticides are chemicals used to destroy pests, control their activity, or prevent them from causing damage. Some pesticides either attract or repel pests. Chemicals that regulate plant growth or remove foliage also are classified as pesticides. Pesticides are generally the fastest way to control pests. In many instances, they are the only tactic available.



Pest Control Failures

Sometimes you may find that even though you applied a pesticide, the pest has not been controlled. You should review the situation to try to determine what went wrong. There are several possible reasons for the failure of chemical pest control.

Pest Resistance

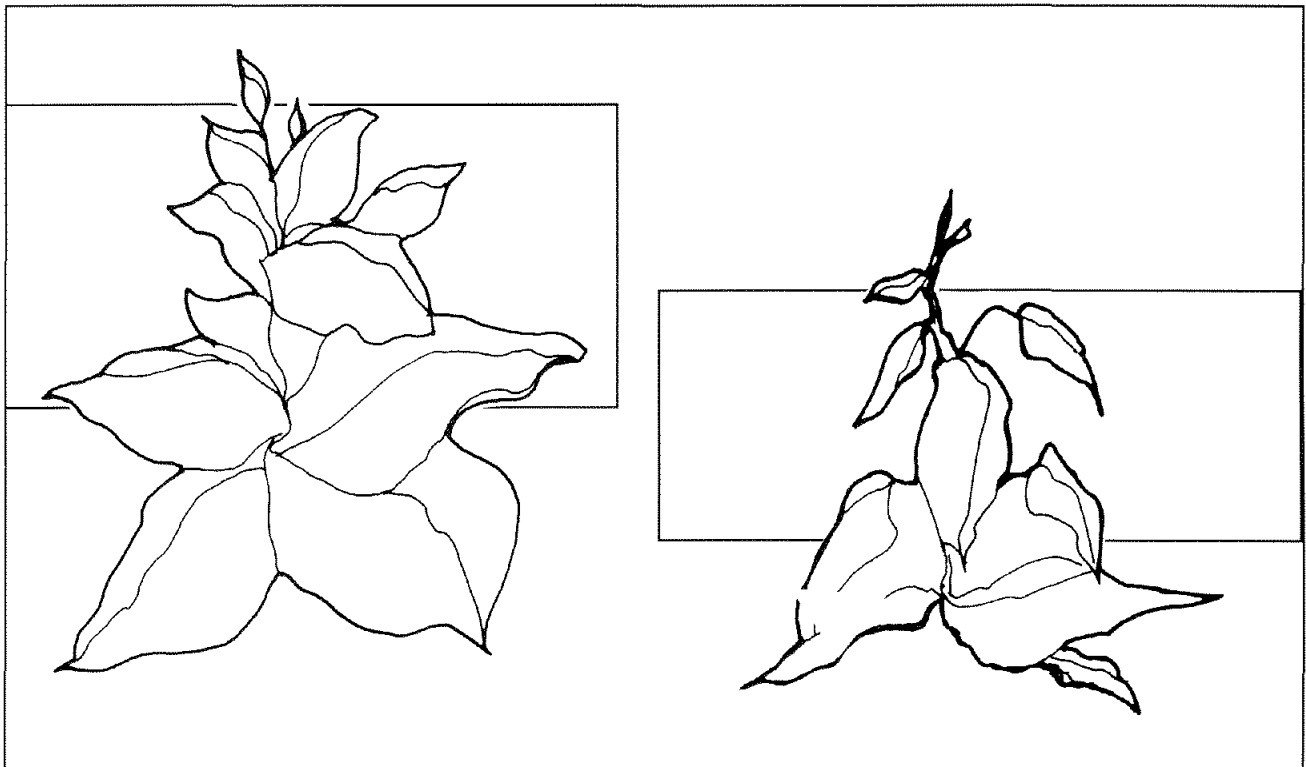
Pesticides fail to control some pests because the pests are resistant to the pesticides. Consider this when planning pest control programs that rely on the use of pesticides. Rarely does any pesticide kill all the target pests. Each time a pesticide is used, it selectively kills the most susceptible pests. Some pests avoid the

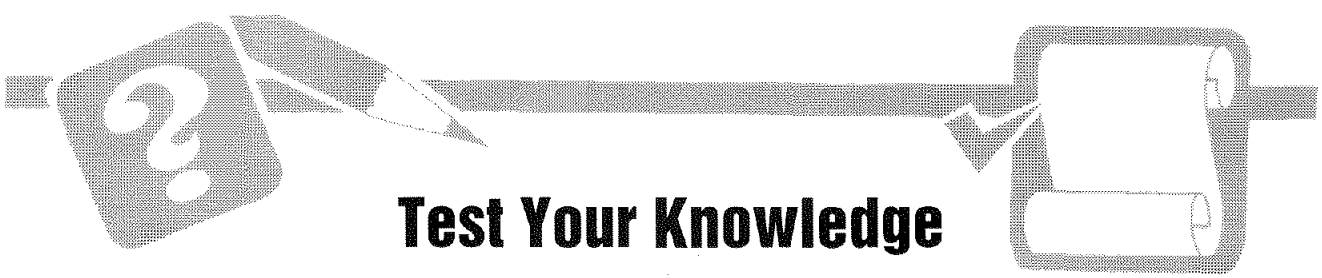
pesticide. Others withstand its effects. Pests that are not destroyed may pass along to their offspring the trait that allowed them to survive.

When one pesticide is used repeatedly in the same place, against the same pest, the surviving pest population may be more resistant to the pesticide than the original population was. The opportunity for resistance is greater when a pesticide is used over a wide geographic area or when a pesticide is applied repeatedly to a rather small area where pest populations are isolated. A pesticide that leaves a residue that gradually loses its effectiveness over time will help select out resistance. Rotating pesticides may help reduce the development of pest resistance.

Other Reasons for Failure

Not every pesticide failure is caused by pest resistance. Make sure that you have used the correct pesticide and the correct dosage and that you have applied the pesticide correctly. Sometimes a pesticide application fails to control a pest because the pest was not identified correctly and the wrong pesticide was chosen. Other applications fail because the pesticide was not applied at an appropriate time — the pest may not have been in the area during the application or it may have been in a life cycle stage or location where it was not susceptible to the pesticide. Also remember that the pests that are present may be part of a new infestation that developed after the chemical was applied.





Test Your Knowledge

Q. What is the first thing you should do when you detect the presence of a pest that you think you may need to control?

A. Identify the pest to be sure you know exactly what the problem is.

Q. How can pest identification help you develop a good pest control strategy?

A. Identification of the pest allows you to determine basic information about it, including its life cycle and the time that it is most susceptible to being controlled.

Q. Explain the differences between continuous pests, sporadic pests, and potential pests.

A. Continuous pests are nearly always present and require regular control; sporadic pests are migratory, cyclical, or other occasional pests that require control once in a while, but not on a regular basis; potential pests are organisms that are not pests under normal conditions, but can become pests and require control in certain circumstances.

Q. Explain what is meant by prevention, suppression, and eradication of pests.

A. Prevention is keeping a pest from becoming a problem; suppression is reducing pest numbers or damage to an acceptable level; eradication is destroying an entire pest population.

Q. What is a threshold? Why should you consider thresholds when you develop a pest control strategy?

A. Thresholds are the levels of pest populations at which you must take pest control action to prevent unacceptable damage or injury. Use of threshold information can improve your pest control strategy by helping you make a decision about when to begin control tactics.

Q. Describe pest monitoring and explain how it can be important to pest control strategy.

A. Monitoring is checking or scouting for pests in an area to determine what pests are present, how many of each kind of pest are in the area, and how much damage they are causing. Monitoring is important to many pest control strategies, because it helps determine if the threshold has been reached and whether control measures have been effective.

Q. Define “integrated pest management” (IPM) and list several possible control tactics that may be used in an IPM strategy.

A. Integrated pest management is the combining of appropriate pest control tactics into a single plan to reduce pests and their damage to an acceptable level. Pest control tactics may include: host resistance, biological control, cultural control, mechanical control, sanitation, and chemical (pesticide) control.

Q. You applied a pesticide, but it did not control the pest. Name three reasons why your control effort might have failed.

A. The failure of the pesticide to control the pest might have been caused by pest resistance, choosing the wrong pesticide, misidentifying the pest, applying the wrong amount, or applying the pesticide incorrectly.

Q. What can you do to keep the pests you are trying to control from becoming resistant to the pesticides you use?

A. Pest resistance can be reduced by using integrated pest management and rotating the types of pesticides used.