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University of Kentucky
College of Agriculture,
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Pesticides and Pesticide Safety

Kentucky Master Gardener Manual Chapter 10

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In this chapter:

Pest is not a biological term for an organism's environmental role as are the words *plant*, *herbivore*, *predator*, and *scavenger*. It is a term for an organism that is either causing damage or is somewhere where it's not wanted. Pests can include plants, insects and their relatives, and microorganisms that cause plant diseases. Often, pests are a problem because we use cultural practices or create conditions favoring organisms that they feed on, compete with, or infect the desirable species.

Key pests are present and often cause enough damage to require regular control (for example, Japanese beetles on roses). Occasional pests require control during some years because of favorable weather conditions (such as fireblight on crabapples). Sporadic pests do not require control most years but may be very damaging in certain circumstances (such as periodical cicadas on newly established trees).

Some natural forces act on all organisms, causing their numbers to rise and fall from year to year. You may not be able to alter the effect of natural forces on a pest population, but you can be aware of their influence and take advantage of them whenever possible. These natural forces include climate, natural enemies, geographic barriers, food and water supply, and shelter.

Unfortunately, natural controls may not act quickly or completely enough to prevent unacceptable injury or damage. That is when other control measures must be used. Those measures include host resistance, biological control, cultural control, mechanical control, sanitation, and chemical control, or pesticides.

The active ingredient in a pesticide product is a chemical that, when used according to label directions, can reduce or control a pest problem. A pesticide application should be thought of as temporary solution to a pest problem, not the way to solve it. Ideally, a pesticide helps to reduce losses or damage until the conditions leading to the outbreak change or those conditions can be corrected.

Accurate identification is the first step in an effective pest management program. (See Chapter 8, *Insects*, in this manual for more information.) Identification is the key to all kinds of information about the pest, including its life cycle, behavior, and recommendations for effective management. Incorrect pest identification is a leading cause of pest control failures and improper use of pesticides.

Your county office of the Cooperative Extension Service can help with pest identification and control recommendations. Diagnostic labs in plant disease, insect, and weed identification are also available, along with help in how to take useful pest samples. Most of these diagnostic services are free.

Types of Pesticides

Herbicides

Herbicides are pesticides that kill plants. Selective herbicides are used in lawns, landscapes, and gardens to control unwanted plants without damaging desirable plants. Nonselective herbicides are used to kill all plants in an area. Selective (and in some cases nonselective) products are used as spot treatments to control weeds in turf and ornamental landscapes to remove undesirable species growing near desirable plants.

A herbicide's mode of action is the way it affects a plant. Some herbicides damage leaf cells, causing them to dry up; others reduce the nutrient uptake. A few interfere with the plant's ability to grow normally or to conduct photosynthesis. The mode of action often dictates when and how a herbicide is used. Herbicides must adequately make contact with and enter the plant. Then, a sufficient amount of the herbicide must move to the site of action to produce the desired effect.

To inhibit germination or seedling growth, use pre-emergent herbicides. To control weed seedlings, these herbicides must be applied to the soil before the seedlings break through the soil surface. In order to come into close contact with germinating weed seeds, these products require rainfall or incorporation into the soil. Some products do not move within the plant, so injury symptoms occur only at the site of uptake. In contrast, systemic herbicides enter through the roots and move up. Their effects are most obvious where the product tends to accumulate.

Postemergent herbicides are applied to the foliage of growing weeds. Those that become active upon contact kill the plant by destroying leaf and stem tissues. They require thorough spray coverage. In contrast, systemic postemergents move within leaves and other green parts to growing points, where they act. These products vary in their ability to move within a plant.

Factors that affect how well these herbicides work include characteristics of plant leaf surface, plant size and age, water stress, air temperature, humidity, and herbicide additives. Differences in the amount of herbicide uptake within the plant often explain the year-to-year variation in herbicide effectiveness.

Plants that can rapidly degrade or deactivate a herbicide can escape its toxic effect. However, plants under stress (such as hot or cold temperatures, high humidity, or physical injury) may be affected by herbicides that they normally tolerate. Also, misapplication, especially at excessive rates, can overwhelm the ability of the plant to degrade or deactivate the chemical and result in plant injury.

Fungicides

Fungicides are pesticides that destroy or inhibit the growth of fungi. Contact fungicides, sometimes called protectant fungicides, remain on plant surfaces after application and do not enter plant tissue. In order to be effective, contact fungicides must be on the plant's surfaces before infection begins.

Systemic fungicides are absorbed into the plant and moved up within the water-conducting tissue (xylem); downward mobility is limited. Systemic fungicides sometimes can suppress the fungus after it has infected the plant.

Fungicide labels usually provide a range of application rates and intervals. Fungicides can be used as a preventive (usually at low rates and/or with long intervals between applications) when a disease outbreak has not yet occurred but when weather favorable for disease is expected. Fungicides may also be used, often at higher rates and/or at short intervals, after an outbreak has occurred and disease pressure is high. Such applications cannot cause sick tissue (yellow or brown leaves, rotted roots) to become healthy again, but they can protect uninfected tissue and new growth. These applications are only effective if the turf is actively growing.

Insecticides

Insecticides can be classified as either broad-spectrum insecticides, which can kill a variety of insects (caterpillars, beetles, aphids, etc.) or as selective insecticides, which affect a limited range of species (for example, caterpillars only) and can help to preserve beneficial species.

Stomach poisons kill insects with chewing mouthparts after they feed on treated plant tissue, while contact insecticides must be absorbed into the body to kill the target. Contact insecticides often are used against sap-feeding pests that do not eat plant tissue and require thorough spray coverage. An insecticide may work as a stomach poison against caterpillars or beetles and as a contact insecticide against aphids or scale crawlers. These products are broken down by moisture, sunlight, or microorganisms, so their residual effect is limited. Consequently, correct timing of applications is important.

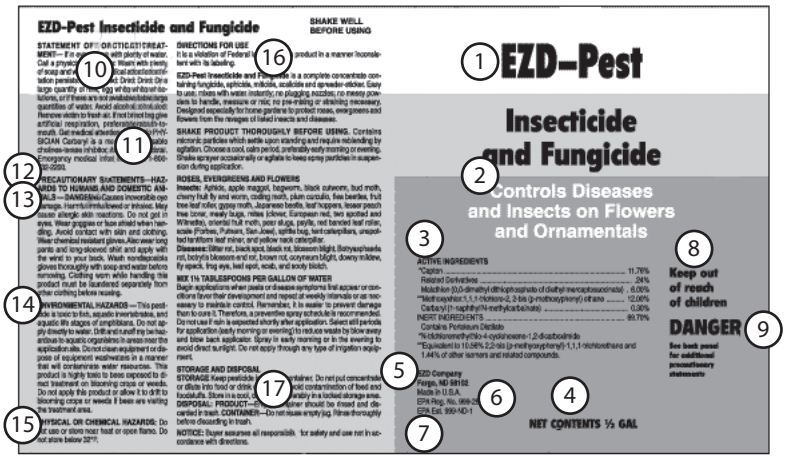
Systemic insecticides are absorbed into plants through the roots or foliage. They can be particularly effective against sap-feeding insects such as aphids and may provide control of some borers and leaf miners. Uptake of a systemic insecticide by the roots and movement to the pest -feeding site may take several weeks, so this type of insecticide may have to be applied several weeks before the pests are active. Systemic insecticides can remain in the plant at effective levels for a long period of time and may have an impact on beneficial insects.

While many insecticides affect the insect's nervous system, products with different modes of action are being used—those that target muscles, insect development and metamorphosis, or parts of the nervous system that are distinctive to insects.

The active ingredients in organic insecticides typically come from plant extracts (pyrethrins, neem), products from soil microorganisms (Bt, spinosyn), or plant fatty acids (insecticidal soaps). The spectrum of pests affected and the length of control following an application of organic insecticide may be limited.

The Pesticide Label

The pesticide label is the way the manufacturer tells you how to use a product safely and effectively. Always read the label before you buy and use a product. Check the directions-for-use section to be sure that the plants, insects, or pathogen, and the site that you intend to treat are listed. Be sure you understand how and when to apply the pesticide with appropriate equipment.



Sections

1. The product name or trade name appears in large print at the top of the label.

2. Type of pesticide—the label must identify the type of pesticide or the types of pests that it controls.

3. The ingredient statement must include the concentration and common (generic) and/ or chemical name of each active ingredient in the product and percentage of inert ingredients.

Many pesticide products, even though produced by different manufacturers, contain the same active ingredient. By purchasing pesticides according to the common name you will be sure you are getting the correct active ingredient no matter what the brand name is. When comparing two different products with the same active ingredient, be sure to compare the amount of active ingredient in each product. Often, different products will contain the same active ingredient but the concentration will vary. Make comparisons based on use rates of pesticides containing the same amount of active ingredient.

For example, Sevin is a brand name of a common insecticide used in the garden and landscape. Its common name is carbaryl; the chemical name is 1-naphthyl N-methylcarbamate. Being able to recognize the common name may allow you to find the pesticide you want under a different brand name. It may be sold as a 50% wettable powder (WP) or a 25% WP. The actual concentration of the active ingredient in the spray tank will be the same, regardless of the amount in the product. The use rate of the 25% WP per gallon of water will be twice that of the 50%WP.

4. The net contents tell how much product is in the container in units of liquid or dry measure.

5. Name and address of the manufacturer.

6, 7. The EPA registration number is unique for each pesticide product. It identifies the manufacturer and product and indicates that the product has been approved by the EPA for the listed uses. The EPA establishment number identifies where the product was produced.

8. All products must bear the statement "Keep Out of Reach of Children."

9. The signal word indicates the acute toxicity of the product.

10. The statement of practical treatment lists the first-aid treatment that should be given in case of accidental exposure to the pesticide.

11. The note to physician lists treatment information and antidotes and often provides an emergency phone number for further information.

12. Precautionary statements identify potential hazards and recommend ways that the risks can be minimized or avoided. Types of precautionary statements include "Hazards to Humans and Domestic Animals," "Environmental Hazards," and "Physical or Chemical Hazards."

13. Hazards to humans and domestic animals. The signal word is listed followed by statements indicating which route(s) of entry (mouth, skin, lungs, eyes) are most likely to be harmful and must be particularly protected. The label will then provide specific action that can prevent overexposure to the pesticide. Protective clothing and equipment required to handle or apply the pesticide will be listed.

14. Environmental hazards warns of pesticide risks to wildlife, birds, fish, bees, and the environment and provides practical ways to avoid harming them. Some examples are "This product is highly toxic to bees exposed to direct treatment or residues on plants,""Do not contaminate water when cleaning equipment or when disposing of wastes," and "Do not apply where runoff is likely to occur."

15. Physical or chemical hazards lists any special fire, explosion, or chemical hazards the product may pose.

16. Directions for use begins with this statement: It is a violation of Federal law to use this product in a manner inconsistent with its labeling. The instructions list what pests the product will control and the plants, crops, or sites the product is intended to protect. The directs also provide information on when, where, how, and in what form the product should be applied, proper equipment to be used, correct dosage, mixing directions, compatibility with other often-used products, minimum time between the application and entry into the treated area for unprotected persons, and possible problems with plant injury.

Harvest interval: When used on fruits or vegetables, there may be a period of time that must elapse from application until the residue drops to a level at which the crop can be safely harvested. It is a mistake to assume that a residue can be washed off if the crop is harvested before the waiting period is complete. The harvest interval is often listed as a number in parentheses following the crop name.

17. Storage and disposal directions: This section of the label will tell you how to store and dispose of the product correctly. Pay attention to specific temperature conditions that are listed.

What pesticide label signal words mean:

Signal Word	Toxicity	Approx. Lethal Human Dose
Danger-Poison/ Danger	Highly toxic or harmful to skin/eyes	A few drops to a teaspoon
Warning	Moderately toxic	1 teaspoon to 1 tablespoon
Caution	Low toxicity to relatively nontoxic	1 tablespoon to 1 pint or more

Exceptions to Label Instructions

Federal law allows pesticides to be used in some ways not specifically mentioned in the labeling. Unless it is a violation of the state law, you may do the following:

- Apply a pesticide at any dosage, concentration, or frequency less than that listed on the labeling
- Apply a pesticide against any target pest not listed on the labeling if the application is to a plant or site that is listed
- Use any appropriate equipment or method of application that is not prohibited by the labeling
- Mix a pesticide or pesticides with a fertilizer if the mixture is not prohibited by the labeling
- Mix two or more pesticides if all the dosages are at or below the recommended rate

Pesticide Formulations

A pesticide formulation is a mixture of chemicals (active ingredient + inert ingredients) that control a pest. Different formulations are developed for safer, easier handling, mixing, or application; reduction of drift off-target; or specific application equipment.

Liquid

Emulsifiable concentrates (EC or E) package the active ingredient with a solvent and an emulsifier so it can be mixed with water and applied with a sprayer. ECs are easy to pour and measure, but the solvent can damage the leaves of some sensitive plants (the solvent has "phytotoxicity"). Also, an EC formulation is easily absorbed if spilled on the skin.

Flowables (F) contain the active ingredient on very fine particles in a milkshake-like liquid. A flowable is easy to pour and measure accurately, but it does not dissolve in water. The small particles are suspended, so the diluted spray must be agitated regularly to keep the particles from settling to the bottom of the tank. Flowables have no solvent, so there is less chance of leaf burn.

Dry

Dusts (D) are fine clay or talc-like products with a low percentage of active ingredient. A dust is ready to apply and requires no mixing or cleanup. However, it is hard to treat the lower surfaces of leaves and large amounts drift-off target.

Granules (G) have an active ingredient that is on or in small clay particles that are applied with a spreader or shaker can. Granules are designed to let the pesticide fall to the soil surface rather than stay on the foliage.

Wettable powder (WP or W) formulations are made by putting the active ingredient in a fine powder. They are like a dust formulation but with a much higher percentage of active ingredient. WPs are mixed with water and sprayed on trees or plants. This type of formulation needs continuous agitation in the spray tank to maintain it in suspension. Inhalation and skin/clothing exposure is a problem.

Soluble powder (SP) is an active ingredient in powder form that dissolves in water.

Other

Ready-To-Use (RTU) products are sold in aerosol cans or hand-pump sprayers. No mixing or cleanup is necessary. This approach is efficient when a small number of plants need to be treated.

Baits (B)are made by adding the active ingredient to an edible or attractive substance. Baits are often used to control slugs, snails, or small ground insects and rodents.

Application Equipment

Pesticide application equipment comes in all shapes, sizes, types, and prices. Select equipment that fits your needs and situation. Following are various types of application equipment:

Hose-End Sprayer—These small, inexpensive sprayers are designed to be attached to a garden hose. With some sprayers, a small amount of pesticide is mixed with water—usually no more than a pint—and placed in the receptacle attached to the hose. With others, a pesticide concentrate is already in the container, which is connected by a tube to the hose opening. When the water is turned on, the suction created by the water passing over the top of the tube pulls the concentrate up and into the high.

Potential problems include poor spray distribution, drift onto the applicator, and drift onto non-target areas. Metering of the concentrate into the water stream can be inaccurate, since it is determined by the water pressure. These sprayers put out an excessively high volume of spray for most needs, using excessive pesticide. All hose-end sprayers should be equipped with an anti-back siphon device to prevent the pesticide from being drawn back into the water system if there is a drop in water pressure.

Compressed Air Sprayer—The spray is mixed in a small tank (generally 1 to 3 gallons). A hand- operated pump supplies pressure during application. A uniform spray concentration can be maintained because the pesticide is mixed with a known quantity of water. Frequent agitation of the spray mixture is necessary when using a dry formulation (WP, WDG, or F). The applicator has excellent coverage control, so this sprayer is a good choice for treating flowers, shrubs, and small trees, but the spray will not reach into tall trees.

Hand-pump Sprayers can be used to treat individual plants or small groups of plants. Many ready-to-use formulations are available for this type of container.

Calibrating Sprayers

Label instructions for spraying pesticides on plants usually are based on mixing specific volumes of product and water (for example, 1 fl oz in 1 gal of water) and wetting the plants to the dripping point. Sprayer calibration is not necessary. Overtreating can occur if more product per gallon than specified on the label is added or if the foliage is wet excessively, both of which can injure leaf tissue, so the applicator should decide how much application to spray.

Label instructions for treating turf or soil, in contrast to those for plants, are usually based on a specific amount of product, such as 3 fl oz in 2 to 5 gallons of water per 1,000 square feet. Calibration is required for turf and soil application—so that the area can be treated evenly at the recommended rate, the applicator needs to know both the sprayer output (ounces per minute) and the amount of time needed to treat a specific area.

Sprayer calibration is relatively easy and should be done before the start of each growing season. The delivery rate will vary with the air pressure in the tank and size of the sprayer nozzle opening. Pressure in the tank will drop as you spray, so be sure to pump frequently in order to maintain a uniform delivery rate. Also, check regularly to make sure the nozzle opening has not become plugged.

Here is the procedure for calibrating a sprayer:

1. Fill the tank with water and pump up the tank pressure. Use a stopwatch as you spray water into a pint jar to determine how long it takes to deliver a known amount. Suppose it takes 30 seconds to deliver 1/2 cup of water or one minute to deliver 1 cup (8 fl oz/minute). Mark the delivery time on the sprayer for future use.

2. Mark off a known area on a driveway or hard surface so you can see the water deposit (for example,10 ft x 10 ft) and measure the time it takes to spray the area evenly and thoroughly at a normal walking speed, which will tell you how long it takes to spray 100 square feet. If it takes 30 seconds to spray 100 square feet, it will take 5 minutes to spray 1,000 square feet. At 8 fl oz per minute, you will use 5 cups, or 40 ounces, of water. If the label calls for 3 tablespoons of pesticide for 1,000 square feet, those 3 tablespoons must be mixed with 40 ounces of water to achieve proper spray coverage.

Mixing Pesticides

Pesticide *compatibility* exists when two or more pesticides can be mixed together without causing adverse effects such as jelling, forming of clumps in the tank, or the pesticides remaining unmixed.

Synergism occurs when mixing of two or more pesticides increases their activity. Synergism may increase control or result in the need for less chemical. It may also be more harmful to a nontarget organism. A synergistic effect can also be undesirable, causing death or damage to the organism that is being protected. No chemicals should be mixed together unless the label specifically says they are compatible.

When mixing of two or more pesticides results in reduced effectiveness, it is called *antagonism*.

In some cases, pesticide labels include information about tank mixes and recommend or caution against specific combinations. Pesticides can be mixed unless prohibited by the label, but the applicator assumes responsibility for any problems that occur.

Some Application Precautions

Before adding pesticide, always check application equipment for leaking hoses or connections and plugged, worn, or dripping nozzles. Before spraying, clear all people, toys, and pets from the area to be sprayed. To minimize drift, apply pesticides only on days with light breezes. If moderate winds (more than 10 mph) arise while you are working, stop immediately. Reduce drift by spraying at a low pressure and using a large nozzle opening. Generally, early morning or late evening are the safest times of day to spray to reduce chance of drift.

Vaporization is the evaporation of an active ingredient during or after application. Some pesticide vapors can cause injury. High temperatures increase vaporization, so choose pesticide formulations that do not evaporate easily, and spray during the cool part of the day. Some products, such as 2, 4,-D, are very volatile under favorable conditions. These products should not be used near highly sensitive plants such as grapes and tomatoes. Do not apply when it is windy or when temperatures following application will climb above 85° F.

Cleaning Equipment

Thoroughly clean all equipment immediately after use. Do not store diluted pesticides in the spray tank. If you have excess pesticide, spray it over an area or on specific plants that are permitted by the label, first checking the label to determine what the safe areas are. Thoroughly clean all spray equipment inside and out with clean water, and don't forget to flush hoses and nozzles. Use caution to ensure that the cleaning water does not damage crops. Do not dump the rinse water in a confined area where it will be concentrated and may become a pollutant. Instead, spray the rinse water over a broad area, further diluting the pesticide. Never rinse pesticides down the drain!

Storage and Disposal

Use and store pesticides away from children and animals.

The best solution to the problem of what to do with excess pesticides is to avoid having them—buy only the amount needed for a year or a season. Calculate carefully how much diluted pesticide is needed for a job and mix only that amount, and use all the mixed pesticide in accordance with labeling instructions.

If you must store pesticides, store them in their original containers in a locked cabinet. They should be protected from temperature extremes, because some can be damaged upon freezing and others can be altered by heat. Do not store pesticides in the home!

To dispose of empty containers, first rinse them out, pouring the rise water into the spray tank. Rinse three times, allowing 30 seconds for the water to drain between each rinse. Before disposing of the cans, wrap them in newspaper and secure them. The empty containers are best placed in refuse cans destined for a sanitary landfill. If possible, break the containers before disposal. Do not burn paper containers.

Never re-use empty pesticide containers other than to refill them with the original pesticide. Never allow children to play with empty containers.

Common Reasons for Control Failures

If the pesticide doesn't work, ask yourself these questions:

1. Was the pest identified correctly? If it wasn't,, the wrong pesticide may have been used or applied at the wrong time.
2. Was the correct rate of pesticide application used? Lack of calibration or faulty equipment can cause control failures.
3. Was the application timed correctly? Sometimes the pests are too large to be controlled by a pesticide or they're in a less susceptible stage. In other cases, the damage is already done and killing the pest has no impact on the problem.

Safety

Safe use of pesticides involves self-protection and knowledge of proper techniques for mixture, application, cleaning of equipment, storage, and disposal. You also need to be able to recognize the symptoms of pesticide poisoning.

Use safety precautions as described below and treat all pesticides with respect, taking care to always follow label directions.

Tips for Safe Handling and Mixing

Here are some tips for safe handling and mixing of pesticides:

- Wear rubber gloves and any other protective equipment, such as eye protection, required by the label.
- Keep children and pets away from the area where you are mixing pesticides.
- Close container caps when you are finished using the pesticide.
- Do not leave containers unattended while applying pesticides.
- Keep a separate set of tools, including measuring spoons and cups and stirring paddles, for mixing and applying pesticides. Use plastic or metal items, not glass or wood.
- Open and mix pesticides outdoors or in a well-ventilated space.
- Mix only the amount of pesticide you will use.
- Have an absorbent material available to clean up a liquid spill, such as cat litter (best), sawdust, or sweeping compound. These materials can also be used to clean up other spills too, such as paints, solvents and fuels. Spread the absorbent on the spill, then sweep it up and put it into a heavy-duty plastic bag. Do not wash down spills with water.
- Any material used to clean up the spill should be properly disposed of, including a broom.
- Small quantities of spilled homeowner pesticides and clean-up materials may be placed into a heavy-duty plastic bag and securely sealed and disposed of in household trash. Immediately wash your hands and any exposed areas of your skin with soap and plenty of water. Shower if necessary.

Personal Protection

The minimum protective equipment to wear during the mixing and application of any pesticide is long pants, a long-sleeved shirt, shoes with socks, and rubber gloves. A hat is needed if you are spraying tree foliage or where you may be exposed to drift from above.

After using any pesticide, wash your hands and arms thoroughly with soap and water. If you have been doing a lot of spraying or dusting, remove your clothes, take a shower, and put on clean clothes. Clothing worn while applying pesticides should be laundered separately from the family wash. After cleaning pesticide-contaminated clothing, the washer should be run once without laundry but with detergent.

Know Symptoms of Pesticide Poisoning

It's important to be aware of the early symptoms and signs of pesticide poisoning. These symptoms are general and similar to those of flu or heat stress. They include fatigue, headache, and dizziness. Exposure to concentrated pesticides can also cause blurred vision, excessive sweating and salivation, nausea and vomiting, and stomach cramps or diarrhea.

First-aid procedures vary somewhat depending upon the pesticide, so see the pesticide label for instructions. In general, however, you want to stop the exposure and wash or flush the area to remove or dilute the pesticide.

Specific information on poisons and chemicals is available from the Kentucky Regional Poison Center of Kosair Children's Hospital, (800) 222-1222.

Other Safety Issues

Pesticides and the Environment

Pesticides can harm the environment if they are not used correctly. Most pesticides break down quickly and remain in the environment only briefly before being changed into harmless products. Some, however, break down slowly and stay in the environment for a long time. They can build up in some plants and in the bodies of animals and people.

Responsible pesticide users know and follow good practices that achieve effective pest control with very little risk of environmental impact.

Anyone who uses a pesticide must ask the following questions:

- How could this pesticide affect the immediate environment where it is being used?
- What is the danger that the pesticide will move out of the use site and cause environmental harm elsewhere?

Off-Target Pesticides

Fine mists of herbicides can drift to nearby gardens or landscape plants and either injure them or leave unacceptable residues. The natural enemies of pests can also be killed by pesticides. To protect beneficial insects, avoid excessive use of insecticides—spray only when pest activity is increasing or high. Use selective products and spot-treat infested areas when possible.

Life in streams or ponds can be contaminated by accidental spraying of ditches and waterways, runoff from sprayed landscapes, or careless disposal of containers. If more than one pesticide will control the pest, choose the one that is the least hazardous to the environment and most useful for the situation.

How to protect pollinators from pesticides

Most people who are active in caring for their lawns and landscaped plants are aware of (and concerned about) the decline of insect pollinators. Reasons for the diminishing numbers of honey bees include combinations of habitat loss, parasites (such as mites), diseases (including bacteria and viruses), and pesticide exposure. Even sublethal exposures to pesticides can negatively impact insect pollinators in many ways, such as negatively affecting their orientation and feeding behaviors, ability to reproduce, and increase their susceptibility to diseases.

The most important action to protect pollinators is to not apply pesticides to plants with open flowers. Encourage pollinators by establishing a variety of plants with different bloom colors and shapes that flower at different times throughout the season. This will provide continuous food (nectar and pollen) sources and nesting habitats for many types of insect pollinators.

Follow steps such as these to reduce exposing pollinators to pesticides:

- Mow all grass areas before applying insecticides. This will remove most of the flowering plants and will reduce bee foraging in treated areas.
- Apply insecticides when the air temperature is below 55°F, bees are less likely to be actively foraging then.
- Use buffer strips between treated turf areas and flowering plants.
- Spot treat infested areas rather than broadcasting applications.
- Whenever possible, use insecticides or formulations that are least toxic to bees.

Insecticides should be the last resort in managing insect pests. While we want to maintain the visual appeal of our yards and landscapes, most insects that feed on our flowers, ornamentals and turf are not harmful to the plant. Low numbers and light to moderate damage should be tolerated, when practical. Both homeowner and commercial use of insecticides should involve careful, responsible, and prudent applications of compounds that are toxic to beneficial insects. Beginning in 2014, some pesticide labels feature a "pollinator protection box" (or bee icon) that alerts applicators to specific use restrictions.

Integrated Pest Management

Integrated Pest Management (IPM) is an approach to pest control that incorporates in a coordinated strategy techniques including cultural practices, resistant varieties, use of natural enemies, and selective pesticide application.

Key IPM principles include the following:

- Control a pest only when it is causing or is expected to cause more harm than is reasonable to accept.
- Rather than to try to eradicate the pest, use a strategy that will reduce the pest numbers to an acceptable level.
- Cause as little harm as possible to everything except the pest.
- What were weather conditions before and after application? Weather can impact pest control. Rain can wash off pesticide residues before the product can work, and poor growing conditions can prevent herbicides from being effective.

Credits

Compressed air sprayer: http://ag.arizona.edu/pubs/garden/mg/pesticides/images/p14-1.gif

Pesticide label: http://www.ag.ndsu.edu/pubs/plantsci/pests/a1098w.gif

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