

PESTICIDES: SAFE AND EFFECTIVE USE IN THE HOME AND LANDSCAPE

Integrated Pest Management for Home Gardeners and Landscape Professionals

Pesticides are designed to be toxic to the pests they target—whether they are insects, cause plant disease, or are weeds or other unwanted home and garden invaders. When used properly, pesticides can protect your plants or home from damage. However, when the label instructions are not followed correctly, plant injury may occur, pests may not be controlled, health may be impaired, and pesticides may contribute to soil, air, or water pollution.

Before you purchase and use a pesticide, learn all you can about the material, how to use it, and how to properly dispose of the empty containers. Also, carefully consider whether or not a pesticide is necessary and if a nonchemical solution might be just as effective.

DEFINITION OF A PESTICIDE

A pesticide is any material (natural, organic, or synthetic) used to control, prevent, kill, suppress, or repel pests. "Pesticide" is a broad term that includes insecticides (insect killers), herbicides (weed or plant killers), fungicides (fungus killers), rodenticides (rodent killers), growth regulators, and other materials like miticides, which are used for mite control, or products that kill snails and slugs (molluscicides).

DECIDING TO USE A PESTICIDE

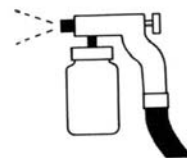
Before using any pesticide, be sure you need it. Verify that the organism you seek to control is really causing lasting damage, and research alternative management methods. Keep in mind that most pests cannot be entirely eliminated—even with pesticides. Some questions to ask before choosing to use a pesticide include:

Is a pest really the cause of your problem? More often than most people

imagine, pesticide products are applied unnecessarily because the cause of damage has been misidentified. Damage can also be the result of other factors such as incorrect irrigation, poor drainage, herbicide toxicity, or physical damage.

How many pests are there and will a pesticide spray be justified? A few caterpillars on a plant might not be a problem that requires any pesticide action on your part, especially if natural enemies of the caterpillars are present. However, a very high population causing severe leaf loss or damage to edible fruits or nuts may mean you would want to control the pest. Be sure to base decisions on presence of pests—not damage levels—and on your knowledge of the pest's life cycle. For instance, often by the time a tree is defoliated (stripped of leaves), pests are gone and sprays will be of no use. In the case of foliar diseases, many fungicides must be applied preventatively before symptoms are noticeable.

Can you change the conditions which have caused the pest to become a problem? Prevention is always the best way to manage a pest problem. Will the conditions change due to the weather or other environmental factors? Is the problem due to gardening practices that can be changed? Each specific pest organism has optimum environmental conditions for causing damage. For instance, powdery mildew in many plants is favored by shade and conditions that favor off-season growth. Sometimes providing plants with a sunny location, opening up canopies to provide air circulation, and avoiding excessive fertilizing will keep the disease from becoming serious. Overhead sprinkling may also reduce powdery mildew problems on some plants.



Hose-end sprayer



Trigger pump sprayer



Compressed air sprayer

Common types of home garden pesticide application equipment.

Other than a pesticide, what else might work? There are many ways to manage pests other than pesticides including:

- *Cultural control* (using the right pruning, fertilizing or watering regime, or selecting pest-resistant varieties or species)
- *Physical control* (for example, using mulches to keep weeds from growing, or solarization for soilborne pathogens or weed seeds)
- *Mechanical control* (hoeing weeds, spraying leaves forcefully with water to remove insects, or using traps or creating barriers to exclude pests)

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- *Biological control* (using beneficial organisms such as insects that eat or parasitize other insects)
- *Replant* (in extreme cases, where a plant requires regular pesticide treatment, consider replanting with a more pest-resistant species or variety)

If you decide to use a pesticide, use it in an integrated pest management (IPM) program that includes use of non-chemical methods. In almost all cases, a combination of measures will provide the most satisfactory and long-term pest control.

CHOOSING THE RIGHT PESTICIDE

The first step in choosing a pesticide is to accurately identify the organism (e.g., the specific insect, weed, or plant disease) that is causing the problem. If the pest is misidentified, you will not be able to choose an effective pesticide or other management strategy. If you aren't confident that you can do this using your own experience, get help from your University of California Cooperative Extension office or other reliable source. Use the plant problem-solving tables in the back of University of California Agriculture and Natural Resources publications, *Pests of the Garden and Small Farm* and *Pests of Landscape Trees and Shrubs* to identify major pests on most common garden plants.

If a pesticide is needed, select one that is effective against your pest and also poses the least risks to human health and the environment. A good source of information for identifying effective, least-toxic methods and pesticides for use against specific pests is the University of California (UC) *Pest Notes* series available at UC Cooperative Extension offices or on the UC Statewide IPM Program Website (www.ipm.ucdavis.edu). When shopping for a pesticide, it is important to consult the label to be sure the target pest and site is listed. However, don't use a label as your primary source for selecting the best control product. In addition to pests that are effectively controlled, pesticide

labels often picture or list pests against which the product is only marginally effective. Getting information from University publications, UC Cooperative Extension offices, or other knowledgeable experts is a better strategy.

Before purchasing a pesticide, also check the label to be sure it is appropriate to use on your plants or treatment site. For instance:

- Be sure the particular type of plant or site you plan to treat is listed on the label.
- Do not use pesticides labeled for use on ornamental plants on plants that will be eaten.
- Never use pesticides labeled for "outdoor use only" indoors.
- Pesticides can seriously damage some plants; read the label to be sure treated plants won't be injured.

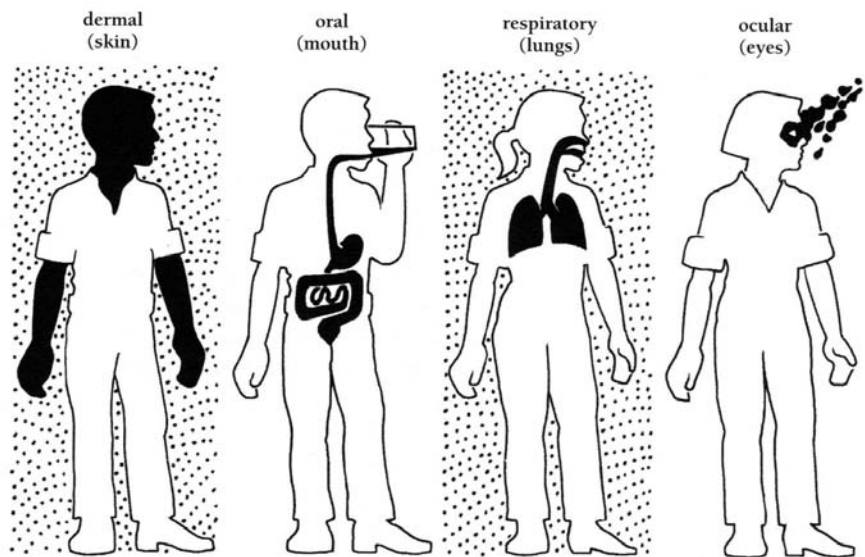
Finally, when choosing pesticides, remember that most pesticides (even the more toxic ones) only control certain stages of the pest. Many insecticides kill only the larval (e.g., caterpillars) stage, not the eggs or pupae. Other insecticides target only adults. Many fungicides are preventive treatments and will not eliminate infections that

have already started, although they may slow their spread. Likewise, some herbicides (preemergence herbicides) kill germinating weeds but not established ones, while others (postemergence herbicides) are effective against actively growing weeds.

LEAST TOXIC ALTERNATIVES

Choose the least toxic pesticide that will solve your problem. Least-toxic alternatives are usually suggested in the UC *IPM Pest Notes*. Examples of least-toxic insecticides include insecticidal petroleum or plant-based oils, soaps, and the microbial insecticide *Bacillus thuringiensis*.

Pesticides are used because they kill or control the target pest. "Selective" pesticides kill only a few closely related organisms. Others are broader spectrum, killing a range of pests but also nontarget organisms. Most pesticides are not without some negative impacts on the environment. For instance, some insecticides with low toxicity to people may have high toxicity to beneficial insects like parasitic wasps or other desirable organisms like honey bees, earthworms, or aquatic invertebrates. Most herbicides selectively kill some weeds, but



The most common ways for pesticide exposure to occur are through the skin (dermal), through the mouth (oral), through the lungs (respiratory), and through the eyes (ocular).

can also kill desirable garden plants if not used properly. Pesticide persistence—or how long it remains toxic in the environment—is also a factor in the safety of pesticides. Pesticides that break down rapidly usually have less negative impact on the environment, but are more difficult to use. Because they don't leave toxic residues that will kill pests arriving hours or days after the application, they must be applied precisely when the vulnerable stage of the pest is present.

The signal words *Danger*, *Warning*, or *Caution* on a pesticide label indicate the immediate toxicity of a single exposure of a product to humans. Over the years, these words have been the consumer's primary guide to relative safety of products. However, signal words do not give an indication of potential for causing chronic problems (e.g., cancer, reproductive problems or other long-term health effects). They also do not reflect potential hazards for wildlife, beneficial insects and many other nontarget organisms. However, most home and garden products are relatively safe and unlikely to cause injury to people if label directions are carefully followed. Precautionary statements on labels give additional information on harmful effects or additional safeguards that should be taken. For more information on hazards of specific pesticides, review the Material Safety Data Sheets (MSDS) available from the pesticide manufacturer or online see the National Pesticide Information Center: <http://npic.orst.edu/gen.htm> or telephone 800-858-7378.

PESTICIDE APPLICATION EQUIPMENT

Read the pesticide label carefully and be sure that you have the proper equipment for applying it safely. You will need protective clothing to protect yourself from exposure even when applying the safest pesticides. Minimally, protective gear should include rubber gloves, eye protection, a long-sleeved shirt, long pants, and closed shoes. Avoid using cotton gloves or light-weight dust masks that may absorb the spray and result in prolonged contact with your skin. Read the pesticide

label carefully for additional protective requirements.

Required equipment varies according to your application site, your choice of pesticide, and your willingness to work with more complicated application devices. For many home and garden pesticide applications, the best choice is to purchase a ready-to-use product in a trigger pump type of sprayer. Ready-to-use products eliminate the need to dilute and mix pesticides or purchase special equipment and are excellent for spot treatments on small plants and shrubs. At the other end of the spectrum are compressed air sprayers, which require careful maintenance and operation as well as precise mixing of chemicals.

If you mix your own pesticides, keep a set of measuring spoons or cups for use *only* with pesticides. It is a good idea to write "PESTICIDE ONLY" on them to distinguish them from your kitchen utensils, and keep them well away from food preparation areas. A locked storage cabinet in a garden shed, garage, or well-ventilated utility area is the best place to store pesticides and equipment you use to mix or apply pesticides. If you are spraying for weed control, keep a sprayer specifically for that purpose and label it "WEEDS ONLY." Otherwise, herbicide residue in the sprayer may injure plants if the same sprayer is used for applying another type of pesticide or fertilizer.

Take a shower as soon after application as possible. Wash clothing separately from other laundry. Never smoke, drink, eat, or use the bathroom after pesticide application without washing first.

Measuring and Diluting Pesticide Concentrates

Properly measuring concentrated formulations of pesticides is essential for their effective and safe use. The application rate for most insecticides and fungicides is given on the label in ounces per gallon of water used in the spray applicator. It is essential that you follow these procedures properly and

Always Read the Pesticide Label.

Important information regarding the pesticide can be found on the product's label. The label is a legal document required for every pesticide registered in the United States. The U.S. Environmental Protection Agency must approve the label. Always keep the product in the original package. Some of the information that is contained on the label includes:

- ✓ Trade name or brand name
- ✓ Active ingredients and their percentage by weight
- ✓ Types of plants or sites where pesticide may be used
- ✓ Pests targeted
- ✓ How much to use
- ✓ How and when to apply
- ✓ Required protective clothing and equipment
- ✓ Signal word defining short-term toxicity to people (DANGER, WARNING, or CAUTION)
- ✓ Precautionary statements defining hazards to people, domestic animals, or the environment
- ✓ Emergency and first aid measures to take if someone has been exposed
- ✓ How to properly store and dispose of the pesticide and empty containers

Active Ingredient
 Glyphosate, isopropylamine salt.....2.0%
 Other Ingredients.....98.0%

KEEP OUT OF REACH OF CHILDREN



CAUTION

See back panel for additional precautionary statements.

NET CONTENTS 32 FL OZ
 (1QT) 946mL

Sidebar 1. How to Dilute an Herbicide.

For most herbicides, the application rate is stated in ounces per 100 square feet or 1000 square feet, so you need to know how large an area you are treating in order to determine the amount of product to use. Suppose you are trying to kill weeds in your lawn and the herbicide label states "use 2 oz. per 1000 square feet." After measuring, you find your lawn is only 600 square feet. Therefore, you would use $(600 \text{ square feet} / 1000 \text{ square feet}) \times 2 \text{ oz.} = 0.6 \times 2 \text{ oz.} = 1.2 \text{ oz.}$ of herbicide to treat the entire lawn.

You also must calculate how much water you need to add to your sprayer. Insecticide and fungicide labels and many herbicide labels tell you how much water to add to dilute your spray. If a certain volume of water is not listed, you can determine how much you need by spraying a small area with the sprayer and a known quantity of clean water. Then divide by the fraction of the area where you plan to apply the herbicide. For example, if you found out that one quart of water covered 100 square feet, you can assume you will need 6 quarts to cover 600 square feet. Mix your 1.2 oz of herbicide in 6 quarts of water.



dilute and apply materials as required. For herbicides and some uses of insecticides and fungicides (such as applications on lawns), the label will indicate the amount of pesticide to use for a given area. In these cases, you'll need to measure the area you are treating to calculate how much to mix up. See Sidebar 1. How to Dilute an Herbicide.

Remember, if the label specifies a dilution rate, you need to follow the label directions precisely. Before mixing up your pesticide, test out your sprayer with water to assure you will cover the recommended area with the recommended amount of diluted spray. If not, you will need to adjust your application rate accordingly by walking or spraying slower or faster.

Insecticide or fungicide directions for fruit or ornamental trees often don't specify areas in square feet to be treated. They often say something such as "wet plants to dripping point, thoroughly cover both sides of leaves". For these applications or for spot treatments, it is also a good idea to test out your sprayer with water to see how much spray you need to cover a fruit or ornamental tree or other area. That way you'll know how much product to mix up.

Never use more than what the directions recommend. The pest will not be controlled any faster and you will be wasting the pesticide, your time, and money while potentially causing plant injury and contaminating the environment with excess chemicals. Mix up only as much as you need immediately; don't store leftover pesticide solutions. They may be susceptible to quality changes at high or very low temperatures or by settling out.

Minimizing Environmental Contamination

Use spot treatments where the pest is most prevalent; avoid widespread applications of the pesticide throughout your garden or home. For spot treatments, mix the pesticide according to label instructions, and apply the mixture only to the affected area. Bait stations for ants, wick or shielded applicators for some herbicides, and tree trunk treatments for certain insects are other ways of limiting environmental exposure.

Be sure pesticides are properly applied to the target plant or site and can't move onto other plants or areas. Pesticides can easily move off target with wind. Do not spray during windy conditions when pesticides can be carried into areas where they aren't needed or wanted.

Be sure the application does not run off or blow into drains, creeks, or other water bodies so you can prevent contamination of water supplies. Avoid applying chemicals just before irrigation or rainy weather, unless labels specify post-application irrigation. Also avoid applying pesticides to hard surfaces such as sidewalks, driveways, and foundations, because they can easily be washed off and go into storm drains.

Follow the guidelines for protecting environmental quality and keeping pesticides out of our waterways.

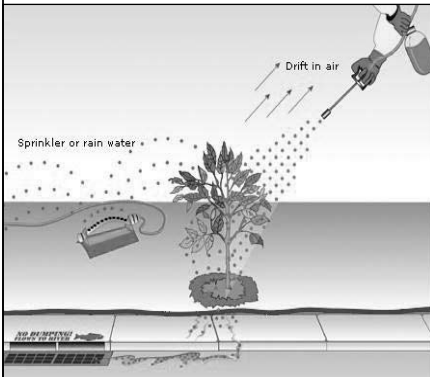
Disposing of Leftover Pesticides

Try to purchase only as much pesticide as you will use in the immediate future. This will eliminate the need to store the unused products. If you can't use up your pesticides in a timely manner, share them with a friend or neighbor who can use them, but always keep these materials in their original containers. Do not use an old soda bottle or anything that could be mistaken for a drink container. People have been poisoned and killed by inadvertently drinking from these containers. Don't dilute more pesticide than you can use right away. Diluted pesticide needs to be applied according to label directions to plants or sites listed on the label and at label rates until the spray tank is empty. Excess diluted pesticide should be disposed of at a household hazardous waste facility.

Do not dump excess, unwanted, or old material down the drain, onto the soil, or into open waterways, gutters, storm drains or sewers, or in the trash. The only legal way to dispose of pesticides is to take them to your local household hazardous waste disposal facility. In California, call the California Environmental Hotline 1-800-253-2687, to find the hazardous waste disposal site closest to you or check on-line at www.earth911.org.

Empty containers of concentrated home use pesticides in the possession of a homeowner on his/her property may

Keep Pesticides Out of Our Waterways by Following These Guidelines.



Pesticides applied in the garden can move off target by drifting in the air or washing off into storm drains or creeks.

- ✓ Be aware of weather patterns and do not apply pesticides just prior to rainfall or during windy conditions.
- ✓ Avoid applying pesticides to hard surfaces such as sidewalks or driveways, where they can easily be washed off.
- ✓ Check pesticide labels for warnings regarding use near bodies of water such as streams, rivers, and lakes.
- ✓ Never dispose of pesticides in storm drains, sinks, or toilets.
- ✓ Under no circumstances should pest control equipment be cleaned in a location where rinse water could flow into gutters, storm drains, or open waterways.
- ✓ Never apply more than the rate listed on a pesticide label.
- ✓ Be aware that some pesticides are more easily carried in surface runoff than others and therefore have a greater potential to move off site during irrigation or storms. The leaching and runoff risks of specific pesticides can be obtained from the UC IPM Website WaterTox database, www.ipm.ucdavis.edu/TOX/simplewatertox.html

be disposed of in the trash without rinsing. Empty containers of ready-to-use products may also be disposed of in the trash. Professionals who use concentrated liquid pesticides must rinse the container three times before disposal. The best time to rinse is when you are using up the last remaining pesticide in the container. Add the remaining pesticide to the sprayer. Add water to the empty pesticide container, put the cap on, swirl the water around the container, and transfer the liquid to the spray tank. Repeat two times. If necessary, add more water to the spray tank to reach the correct concentration. This way, you will have rinsed the bottle three times and used the rinse water to make the pesticide application.

Don't pour unused rinse liquid down any drain or sewer or in the trash. Unused rinse liquid is considered hazardous waste and must be disposed of properly at a hazardous waste facility or as suggested above.

Indoor Versus Outdoor Pesticides

Use only pesticides specifically labeled for indoor use inside the house. Many outdoor pesticides are designed to break down into less toxic substances with ventilation and in the daylight and the rain. Without these conditions the pesticides may linger and cause toxic conditions for humans or pets.

Hiring a Pest Control Company

If you do not have the time or ability to research your pest problem and safely apply the appropriate material to control it, you may want to hire a pest control service to do the job for you. See the *Pest Note: Hiring a Pest Control Company* for information on how to select a contractor.

Licensed pesticide operators also have access to some products not available in retail stores. Many pest problems, such as termites or management of problems on large trees, require special pesticides or equipment and technical training for most effective management. Although professional services may

be expensive, the investment may be worth it to solve a serious problem.

SUGGESTED READING

Flint, M. L. *Pests of the Garden and Small Farm*. 1998. Oakland: Univ. Calif. Div. Agric. Nat. Res. Publ. 3332.

Dreistadt, S. H. *Pests of Landscape Trees and Shrubs*. 2004. Oakland: Univ. Calif. Div. Agric. Nat. Res. Publ. 3359.

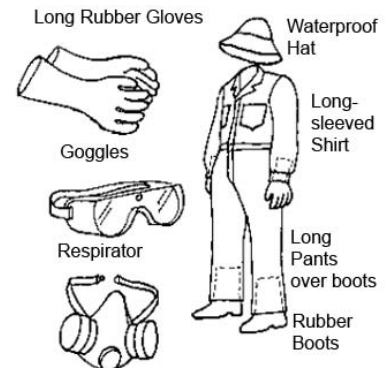
O'Connor-Marer, P. J. *Safe and Effective Use of Pesticides*. 2000. Oakland: Univ. Calif. Div. Agric. Nat. Res. Publ. 3324.

Pittenger, D. R., ed. *California Master Gardener Handbook*. 2002. Oakland:

Use Pesticides Safely.

- Be sure plant and site is on the label.
- Be sure pest is on the label.
- Follow label directions for mixing.
- Follow label directions about wearing protective clothing.
- Check label for other precautions.

Protective Clothing and Equipment.



Univ. Calif. Div. Agric. Nat. Res. Publ.
3382.

Wilén, C.A., et al. 2006. *Pest Note: Hiring a Pest Control Company*. Oakland: Univ. Calif. Div. Agric. Nat. Res. Publ. 74125. Also available online, www.ipm.ucdavis.edu.

Online: Check out more Pest Notes at www.ipm.ucdavis.edu. ♦

For more information contact the University of California Cooperative Extension or agricultural commissioner's office in your county. See your telephone directory for addresses and phone numbers.

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To simplify information, trade names of products have been used. No endorsement of named products is intended, nor is criticism implied of similar products that are not mentioned.

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WARNING ON THE USE OF CHEMICALS

Pesticides are poisonous. Always read and carefully follow all precautions and safety recommendations given on the container label. Store all chemicals in the original labeled containers in a locked cabinet or shed, away from food or feeds, and out of the reach of children, unauthorized persons, pets, and livestock.

Confine chemicals to the property being treated. Avoid drift onto neighboring properties, especially gardens containing fruits or vegetables ready to be picked.

Do not place containers containing pesticide in the trash or pour pesticides down sink or toilet. Either use the pesticide according to the label or take unwanted pesticides to a Household Hazardous Waste Collection site. Contact your county agricultural commissioner for additional information on safe container disposal and for the location of the Household Hazardous Waste Collection site nearest you. Dispose of empty containers by following label directions. Never reuse or burn the containers or dispose of them in such a manner that they may contaminate water supplies or natural waterways.

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