

Using Pesticides Safely in the Home and Garden

David Trinklein, Division of Plant Sciences

Pet owners washing their dogs with flea and tick shampoo; housekeepers scrubbing bathroom fixtures with mold and mildew removal agents; lawn enthusiasts applying granular crabgrass preventers. What do these people have in common? They all are using a pesticide of one type or another.

Some people think pesticides are only used for controlling insects. By definition, a pesticide is any product that kills or repels pests, including weedy plants or plant diseases, animals such as moles, and even household mildews, molds and bacteria. Therefore, products designed for use as disinfectants, toilet bowl cleaners, insect foggers and even pet flea collars are considered to be pesticides. If you are unsure whether any product qualifies as a pesticide, check the package label for pesticide registration numbers issued by the U.S. Environmental Protection Agency. Pesticide labels carry two EPA registration numbers: the first number identifies the product's manufacturer and the second identifies the specific pesticide.

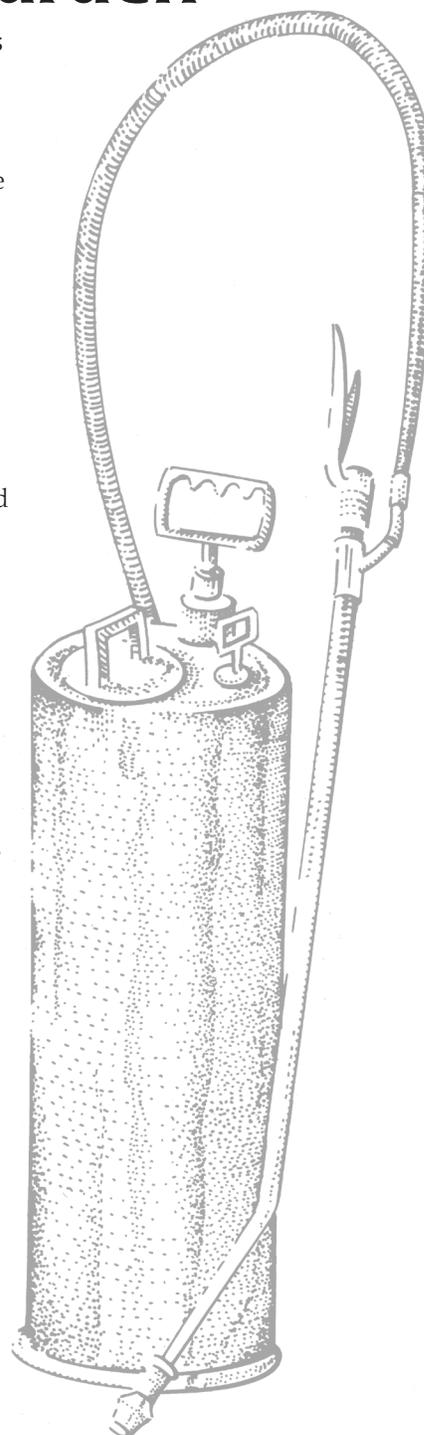
Pesticides serve many purposes around the home and garden. They modify the appearance of lawns by eliminating unwanted plants we consider weeds. They can increase production in gardens and fields by reducing losses caused by insects, diseases and weedy species. They help us keep our living spaces clean and can even protect our health if used properly. Yet, it is important to remember that pesticides are poisons and when used carelessly, they can pose dangers to humans, wildlife and our environment.

The American Association of Poison Control Centers reports thousands of pesticide-related exposures each year. Although many of these exposures are minor in nature, some are more serious and require medical attention. Perhaps most alarming, about one-third of poisoning cases involve children younger than 6. Children are often at greater risk from pesticide exposures, which can affect their growth and development.

Safety topics inside

Select control method	2
Understanding toxicity	2
Handle with care	3
Apply the correct amount	4
Prevent exposure	4
Prepare for emergencies	5
Protect the environment	6
Safe storage and disposal	6

Pesticides should not necessarily be considered the first line of defense against a gardening problem. For example, hand-weeding can effectively and safely control minor weed infestations. The same is true for hand-removal of light populations of certain insects. There are times, however, when the use of pesticides is warranted. The purpose of this chapter is to help Master Gardeners avoid problems and make effective, efficient use of pesticides in the garden and home environment.



Select your control method

Pesticides should be considered as one of a number of options for managing a pest outbreak. Often, nonchemical control methods work just as well or better to prevent or manage a pest outbreak. Many pesticides target only certain types of pests. Thus, accurate identification of the problem is the critical first step in the process of selecting one or more appropriate control measures.

Integrated pest management for lawn and garden

Integrated pest management (IPM) incorporates cultural, mechanical, biological and chemical control methods in a common-sense approach to pest management. IPM emphasizes establishing and maintaining healthy plants.

Healthy, unstressed plants are better able to resist insects and diseases and compete with weeds.

In fact, many common plant problems are abiotic conditions — those that are not caused by a living pest. Such conditions can be physical, environmental or chemical. Typical causes of abiotic problems include poor planting or mulching methods, stress from cold or drought, overwatering and air pollution. If such problems are the real source of a plant disorder, pesticides will not provide a long-term solution.

When pesticides are the right choice

When you have eliminated possible abiotic causes of your plant problem, use of a pesticide may be appropriate. If so, how do you decide which one to use? Many products are classified as pesticides and sold through lawn and garden centers, hardware retailers and even grocery stores, and their commercial claims can be confusing and sometimes even

inaccurate. To find the right pesticide requires that you ask the right questions and read product labels.

In the world of pesticide use, there is one simple rule that must be followed: “The label is the law.” It is against the law to use a pesticide for a purpose or in a manner other than that dictated by its label. Therefore, careful reading of the label is the first crucial step in pesticide usage. Check product labels to see

if your particular pest is listed as one that the product will control (Figure 1). Never assume that a product will control a pest that is not listed on its label. For example, if you wish to control dandelions in your lawn, be sure that the product label claims it controls “dandelions.” If the label does not name the pest you wish to control, the risk of a control failure falls upon you and not the retailer or the manufacturer of the product. In many instances, you may have more than one product choice to control your problem. If so, do not choose on the basis of cost alone; consider products that may be more friendly to the environment, easier on beneficial organisms and perhaps easier and safer to use. In the long run, you might save money and also prevent future problems.

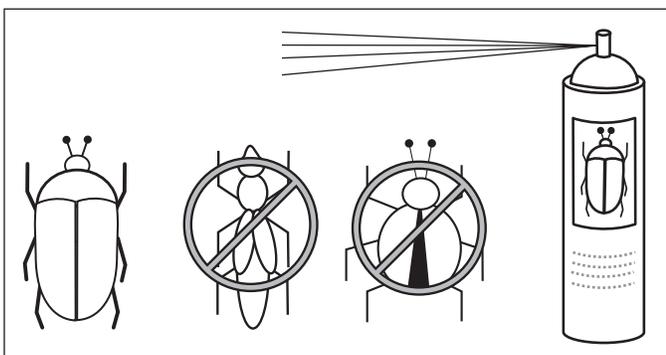


Figure 1. When choosing a pesticide, do not use a product unless the label lists the specific pest you want to control.

Understanding pesticide toxicity

All pesticides are poisonous, some more so than others. Their relative toxicity, and hence the danger they pose to warm-blooded animals, is expressed in a measure known as LD₅₀, which stands for lethal dose, 50 percent. The LD₅₀ is the amount of a pesticide that resulted in the death of 50 percent of a test animal population. It is based on milligrams (mg) of active ingredient per kilograms

(kg) of body weight. Thus, the lower the LD₅₀, the more toxic a pesticide is to people (Table 1).

For simplicity's sake, a pesticide label contains one of three "signal words" to indicate the product's relative toxicity to humans:

- DANGER applies to those pesticides with an LD₅₀ of less than 50. These are highly toxic pesticides that require special certification to buy and use.
- WARNING refers to pesticides that are only moderately toxic. The LD₅₀ range for these pesticides is between 50 and 500.
- CAUTION is applied to pesticides with low to very low human toxicity. The LD₅₀ for this group is 500 or more. Most of the pesticides available to the homeowner contain the signal word CAUTION on their labels.

Regardless of the signal word on a pesticide label, remember that every pesticide is toxic and has the potential to poison. Therefore, always read and follow all of the directions on the label each time you use a pesticide.

Handle with care

When handling pesticides, keep in mind that, as mentioned in the preceding section, they are poisons and pose risks, at least to some degree. Most products formulated for use in and around the home are in very low concentrations.

Many come ready-to-use because they are already diluted. Many of the same

active ingredients found in home and garden products are available in more concentrated formulations and sold under different brand names for agricultural and industrial uses. Generally, most of these concentrated products are not listed as approved for home use — that is, they are illegal to use in the home environment. Other products are only available to licensed pest control professionals because of toxicity and environmental concerns. If you have a serious pest problem, such as a termite infestation, it is best to consult with a professional. Pest-control firms have personnel who are specially trained, certified and licensed to handle these types of jobs. For more information on choosing a professional applicator, see MU Extension publication G7501, *Selecting a Professional Pest Control Service*.

It's always better to be safe than sorry. Read the product label, and be prepared to use the product in a responsible way. When children, pets or wildlife could be present, take special precautions:

- Never place rodent baits where children, pets or wildlife will come in contact with them. Even so, be aware that rodents will sometimes move pesticide pellets instead of eating them right away, storing them in unlikely places that could pose a hazard. Pellets — sometimes colored

Table 1. Interpreting toxicity categories and signal words on pesticide labels.

Toxicity category	Oral LD ₅₀ (mg/kg)*	Signal word	Approximate adult lethal dose (oral)
I	0–50	DANGER/POISON	Few drops to 1 teaspoon
II	50–500	WARNING	1 teaspoon to 1 ounce
III	500–5,000	CAUTION	1 ounce to 1 pint or pound
IV	5,000 or more	CAUTION	More than 1 pint or pound

* LD₅₀ (lethal dose, 50 percent) is the amount of a pesticide that resulted in the death of 50 percent of a test animal population, expressed in milligrams (mg) of active ingredient per kilograms (kg) of body weight.

Pest management options

Natural pest control for lawn and garden

Numerous organisms feed upon or infest insect pests. Natural enemies including predators, parasites and pathogens combat insect pests. Microbial insecticides containing the soilborne bacterium *Bacillus thuringiensis* (Bt) are popular for the control of a variety of insects. Botanical pesticides, such as products containing pyrethrum and sabadilla, are less likely to pollute water or air and break down quickly in the environment.

Pest management options

Cultural and mechanical methods for lawns

- In areas that don't receive lots of sunlight, plant shade-tolerant turf species or consider an alternative groundcover.
- Mow at the proper height — most cool-season grasses should not be mowed shorter than 2 to 2½ inches. Taller turf is more competitive with weeds and is more drought tolerant during the summer.
- Only fertilize cool-season lawns during the spring and fall. Excessive amounts of nitrogen during the summer encourages turf diseases.
- Remove thatch when accumulation exceeds half an inch. Thatch is a haven for insects and disease organisms.
- Water deeply and infrequently; shallow, frequent sprinklings encourage shallow, weak roots, crabgrass and some diseases.

brightly with a candy-like appearance — have been known to show up in shoes, cabinets and toy storage areas.

- Remove or cover pet food and water dishes when applying chemicals.
- Remove children's toys when applying chemicals.
- Store all pesticides out of reach of children and in their original containers. Pesticides stored in food or soft drink containers invite accidents that can turn tragic. Children and even adults associate such containers with

something good to eat or drink, and not something that is a poison. Such misuse of a pesticide is illegal and can expose you to serious liability problems. Do not allow children or others in your home to become a statistic of the American Association of Poison Control Centers.

Pest management options

Cultural and mechanical methods for gardens

- Consider whether your garden location has adequate sunlight and drainage. If you water the garden, use an irrigation method that minimizes wetting of the foliage to discourage diseases.
- Select plant species adapted to climatic and soil conditions in your area and garden location.
- Select disease-resistant plants.
- Use proper plant spacing to improve light penetration and air circulation.
- Maintain the proper soil pH and fertility levels.
- Rotate plant sites from year to year to disrupt the life cycle of annual pests.
- Mulch correctly to help control weeds, conserve soil moisture, reduce soil erosion and avoid insect problems.
- Regularly remove pest-infested residues, especially during fall cleanup season.

Apply the correct amount

When applying pesticides, the adage “if a little is good, more is better” definitely **should not be** followed. Strive for judicious use, guided by the directions on the label. These chemicals are generally not cheap; using them at unnecessarily high rates of application represents wasted money, time and energy. Extra products can also pose storage and disposal problems. Excessive use increases the potential for environmental harm, making it more likely that pesticides will run off into surface water or leach into groundwater or wells. Overapplication increases the chances that pesticides will damage desirable plants and beneficial organisms and lead to the buildup of resistance in target pests. Moreover, applying pesticides at excessive rates beyond label directions is considered an illegal misuse of the product.

Fortunately, manufacturers make it easy to use pesticides responsibly. Many pesticide products for homeowners now come ready-to-use, with no additional mixing required for

liquid formulations. If a concentrate needs to be mixed with water, the label will usually state the desired concentration that should be achieved before application. Some liquid products may list the proper rate as an amount to apply per unit area. For most lawn-care products, this application rate will be given as an amount of pesticide per 1,000 square feet. When ranges of rates are given on the label (for example, 2 to 4 ounces per 1,000 square feet), it is best to start with the lowest amount. If satisfactory control is not achieved, then a higher rate can be used the next time the pesticide is applied. It is important to calculate the dimensions of the area to be treated in order to mix the proper amount into the application equipment, usually in a hose-end or hand-pump sprayer.

Product labels for many of the granular materials on today's market include a table that gives the correct setting to be used with popular granular lawn spreaders. These settings determine the flow rate and distribution of the product and vary depending on the size and weight of the granules. Attention to application rates helps ensure accurate delivery of the appropriate amount of a pesticide product to a site.

Prevent exposure

Pesticides can enter the body in several ways: ingestion, inhalation or contact with the skin (Figure 2). Surveys indicate that most exposure victims contact pesticides through their skin. For this reason, the minimum personal protection equipment (PPE) that must be used when mixing and applying the product is listed on the label. Note that using more than the minimum required PPE is perfectly fine and legal. The most important PPE to wear are gloves. Some labels

will specify waterproof or chemical-resistant gloves; keep in mind that waterproof does not necessarily mean chemical-resistant. Avoid gloves made of cotton, canvas or leather when handling pesticides, as these materials tend to absorb and hold residues in contact with the skin. Some pesticide labels of products approved for use around the home will indicate that applicators should wear a long-sleeved shirt and full-length trousers or a pair of coveralls. If coveralls are the preferred garment, disposable one-piece suits are available in water-resistant materials such as Tyvek. Eye protection, such as face shields, protective goggles or safety glasses, may also be necessary when using some products, particularly during the mixing process. Regular eyeglasses for correcting vision **do not** provide adequate protection against pesticide exposure.

When the pesticide application tasks have been completed, follow proper procedures for discarding disposable gear or pesticide containers and for cleaning reusable protective gear with soapy water. Rinse, dry and store protective gear that can be reused in an appropriate location away from children and pets. Finally, bathe thoroughly and change into clean clothing. More detailed information on protective gear is outlined in the MU Extension publication G1917, *Personal Protective Equipment for Working with Pesticides*.

Clothing that has been worn while handling pesticides should be laundered separately, especially if there are children in the household, and then line-dried. If the clothing has been heavily contaminated during pesticide application, it should be discarded. Further details on laundering clothing containing pesticide residues may be found in MU Extension publication G1914, *Laundering Pesticide-Contaminated Clothing*.

Prepare for an emergency

Even when proper precautions are taken, accidents sometimes happen. What do you do if you or someone else experiences dizziness, headache or nausea that you suspect is related to pesticide exposure? In these situations, do not take any chances; contact a medical professional and be ready to take the pesticide label along if you need to go to a hospital.

If you are using pesticides, be sure to take time **in advance** to read label directions so that you know the actions to take if exposure occurs. If you wait until a problem happens, you might not be able to clearly understand or follow instructions. The label will contain specific information about remedial treatment that medical professionals can follow. In some cases, recommended treatments should start at home before you can reach medical help.

The American Association of Poison Control Centers (AAPCC) has a system of regional poison control centers that are staffed 24 hours a day, seven days a week, with specially trained medical professionals. More information about the centers and poison prevention is available online at <http://aapcc.org>. In case of a poisoning or possible poisoning, call the AAPCC emergency hotline at 800-222-1222 to quickly receive good advice and help in contacting the nearest poison

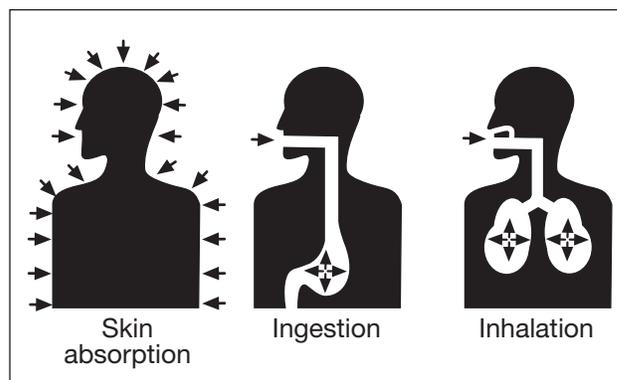


Figure 2. Exposure to pesticides can occur through the skin, by ingestion, and by inhalation.

Pest management options

Chemical pest control for lawns and gardens

Once you have correctly identified the pest causing unacceptable damage and other control measures have proven impractical or have failed, the careful selection of a pesticide may be a viable alternative. You should follow some guidelines if you will use pesticides:

- Read the label carefully – it tells you when, where and how to use a product.
- Apply only the amount specified on the label and apply only to plants and areas listed on it. Overapplication wastes money and increases environmental hazards.
- Wear personal protection equipment listed on the label. Do not launder clothing contaminated with pesticides with other clothing.
- Make sure the pest you wish to control is listed on the label. Do not mix different pesticides unless permitted by the product's label directions.
- Keep pesticides out of the reach of children and pets and in their original containers with labels attached.
- Check the weather; some pesticides are not effective if washed off foliage, while others may need to be watered into the soil for best results. Never spray pesticides on breezy days; spray drift poses serious health risks for nontarget plants and animals.
- Never apply pesticides to areas around ponds, streams, wells and other water sources unless the pesticide is labeled for use in these areas.

Understanding the pesticide label

You should be able to answer these questions for any pesticide that you use. It is important to understand the guidelines for application and disposal of pesticide products.

1. What is the brand name of this product?
2. Who is the manufacturer of this pesticide?
3. What does this pesticide control?
4. What is the common name of the active ingredient in this formulation?
5. What should you do initially for a person that you suspect has been exposed to this pesticide?
6. What is the recommended application rate for the problem you want to control?
7. What is the signal word listed on the pesticide container's label?
8. Is it safe to apply this product to open areas of surface water such as ponds?
9. What is the EPA registration number of this product?
10. Is it legal to burn the empty container in your state after all of the product has been used?

For more information, see MU Extension publication G1911, *Understanding the Pesticide Label*.

control center. However, if someone has collapsed or is not breathing, first call 911.

Protect sensitive environmental areas

Sensitive areas where pesticide applications are often prohibited or limited include buffer zones near water sources and wells, playgrounds or schools, and beehives. Some states may have no-spray zones near designated natural areas, or fields or gardens posted as production areas for certified organic crops. Avoid applications near food crops and ornamental plants not listed on the label of the pesticide being used.

To protect yourself and your neighbors, and to help avoid legal liability, read pesticide labels for any recommended or required limits on usage. Especially avoid applying chemicals when it is windy or when a significant rainfall event is forecast. Such weather conditions set the stage for chemicals to move "off-site" beyond the target area, a situation that can result in fines or lawsuits.

If pesticides are going to be applied to vegetable or fruit crops, be certain to check the product label for the preharvest interval, that is, the amount of time that should elapse between application of the pesticide and harvesting of the particular vegetable or fruit for consumption, freezing or canning. MU Extension recommends not eating any fruit or vegetable that has been tainted with products that are not specifically labeled for application to that particular food crop.

Finally, maintain accurate records. Commercial pesticide applicators are required by law to keep records. For the homeowner, good records can help to evaluate how well a particular product worked at a given application rate; to estimate the amount of pesticides that will be needed in future growing seasons; and, possibly, to protect you from legal action if you are accused of improper pesticide use.

Store and dispose of pesticides properly

The best way to avoid the need to store excess pesticides is to buy only the amount needed to do the job. With so many home-use products packaged in ready-to-use formulations, pesticides generally can be used up within a short time. Try to buy these types of formulations rather than large quantities of undiluted, concentrated products. In the long run, this can save money and storage problems.

Immediate and complete use of every pesticide product may not always be practical, however. When it is necessary to store a pesticide, be sure to store it in its original container away from food, feed, fertilizers and water. The storage location should be locked and well out of the reach of children and pets. For short-term storage, a locked shed or cabinet will usually suffice.

Long-term storage brings additional concerns, mainly with regard to temperature and moisture requirements. Some products clearly indicate on their labels, under the "Storage and Disposal" section, statements such as "do not allow to freeze," or they will give precise temperature ranges or moisture conditions for storage. Temperature extremes can cause chemical changes in a product's ingredients and can render them ineffective. Temperature extremes can also cause some products to undergo physical changes that cause their ingredients to form crystalline or gelatinous masses and their components to separate. Dry products, such as granular formulations, can better tolerate

temperature extremes but can be ruined by moisture. These formulations have a high affinity for moisture, and once they have absorbed any available moisture, they can quickly form a hard, insoluble mass.

There are several options for proper disposal of pesticides. The best one is to use all of the pesticide by applying it to an approved site for an approved use. If you don't have an immediate use for a product, there is a chance that someone you know may be able to use it. Another option is to store the product only until it can be taken to a community household hazardous waste collection site for disposal.

Do not pour or flush pesticides down drains, toilets or sewers, and do not leave them on the ground. Do not put unused pesticides in the trash unless the label specifies that this is acceptable and legal. However, be aware that throwing unused pesticides away in household garbage may not be acceptable to the company or utility that hauls your trash because it is likely to cause pollution. Pesticide containers must be disposed of in an approved way. Most states prohibit burning any pesticide container. Under no circumstances should you reuse a pesticide container to carry or store any other substance than the original product. Mixing chemicals, sometimes even in small amounts, can cause unexpected reactions or increased toxicity that could harm humans, pets, wildlife or the surrounding environment. As emphasized throughout this chapter, read the pesticide label. In addition to the information already mentioned, the label will describe appropriate disposal options for the product and its container.

Once a pesticide container is empty, make sure it is thoroughly cleaned. With liquid formulations, the recommended way to prevent residues is to triple-rinse the container and then to add the water you use for rinsing (called rinsate) directly back into the sprayer as makeup solution. For bags and containers of dry formulations, thoroughly shake these directly onto the site or into the spreader.

For up-to-date information on safe and legal disposal of pesticides and pesticide containers, check the website of your state's agriculture department or natural resource agency. In summary, the best choice is to buy what you need and use it completely or give it to someone else who can. Alternatively, find the nearest hazardous waste collection facility and deliver it as required by their guidelines, or keep the product securely stored until the next community household hazardous waste collection event in your area.

Acknowledgments: *Mary Kroening, formerly with the MU Extension Division of Plant Sciences, was the original author of this publication, and Fred Fishel, formerly with the MU Department of Agronomy, was a contributing author.*

Material safety data sheet

In addition to the pesticide label, which provides definitive information on application, storage and disposal of pesticides, manufacturers of pesticides publish a *material safety data sheet*, or MSDS, for every pesticide product. The MSDS provides up-to-date environmental and toxicological information about a specific pesticide. Chemical properties, such as vapor pressure and water solubility, are given in Section 9; toxicological information in Section 11; and ecological information in Section 12. MSDS documents are readily available online.

For more information, see MU Extension publication G1913, *Understanding the Material Safety Data Sheet*.

For further information

If you have questions that this publication or other references do not answer, contact your local extension center.

MU Extension publications at extension.missouri.edu

EQM100	<i>An Introduction to Assessing the Environmental Safety of Your Home</i>
G1911	<i>Understanding the Pesticide Label</i>
G1913	<i>Understanding the Material Safety Data Sheet</i>
G6202	<i>Disease Prevention in Home Vegetable Gardens</i>
G7273	<i>Least-Toxic Control Methods to Manage Indoor Plant Pests</i>
G7274	<i>Aphids, Scales and Mites on Garden and Landscape Plants</i>
G7501	<i>Selecting a Professional Pest Control Service</i>
G7510	<i>Pesticide Dilution Table</i>
G7520	<i>Pesticides and the Environment</i>
M163	<i>Managing Insect Pests in the Home Vegetable Garden</i>
WQ551	<i>Calibrating Home Garden Equipment</i>

Related websites

Missouri Department of Agriculture – <http://agriculture.mo.gov>

Missouri Department of Natural Resources – <http://dnr.mo.gov>

MU Extension Plant Protection Programs and Pesticide Education –
<http://ipm.missouri.edu>

U.S. Environmental Protection Agency – <http://epa.gov>

National Pesticide Information Center – <http://npic.orst.edu>

American Association of Poison Control Centers – <http://aapcc.org>

The *Missouri Environment and Garden* newsletter, published regularly throughout the gardening season – <http://ipm.missouri.edu/meg>