

# Apply Pesticides Correctly

A guide  
for private  
applicators



U.S. Department  
of Agriculture

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U.S. Environmental  
Protection Agency

## Private Pesticide Applicator

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# Recertification

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UNIVERSITY EXTENSION  
University of Missouri-Columbia

Pesticide applicators who have a Private Applicator's License are required by law to be recertified within five years following issuance of the license and within each subsequent five-year period.

To become recertified read — carefully for understanding — this brochure. On fulfilling this requirement, please return to the area extension office and sign a recertification verification form. If corrections are not required (address changes, etc.) the extension person will give you your license.

If corrections are required on the license or the license is not available, you or the extension personnel may contact John Hagan, Supervisor, Missouri Department of Agriculture, Bureau of Pesticide Control, P. O. Box 630, Jefferson City, Missouri 65102, and prompt attention will be given.

For additional information on pests and pesticides, please refer to University of Missouri-Columbia Science and Technology Guides, to extension's area agronomy specialists and agriculturists, and to the state extension specialists listed in this brochure.

**NOTE: To be recertified, complete these steps: (1) Read this brochure and accompanying materials carefully. (2) Sign the recertification form. (3) Retain this brochure and UMC Guides for future reference. REFER to the latest *Missouri Restricted Use List* for the chemicals registered for restricted use in Missouri.**

## Recognizing local pests, environmental situations, and principles of Integrated Pest Management

Crop production in Missouri is subject to many weed, insect and disease problems each year that can be costly unless properly controlled. The key to proper control is proper identification. For instance, the identification of a weed species that will have to be controlled must be made before the appropriate herbicides can be selected or other control measures implemented.

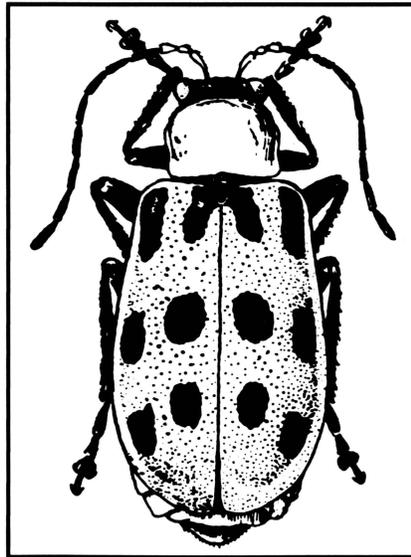
**ASSISTANCE WITH THE IDENTIFICATION** of pests, together with assistance in the safe and proper application and disposal of pesticides is listed under the pest or safety items below.

**Weeds:** Assistance with the identification of weeds and evaluation of local situations can be made by Area Extension Agronomists and Agriculturists in each County Extension Center; or the State Extension Associate, Weed Specialist, W. W. Dierker, 45 Agriculture Building, University of Missouri, Columbia, Missouri, 65211, 314-882-3256 or State Extension Weed Specialist Michael DeFelice, 2-14 Waters Hall, University of Missouri, Columbia, Missouri 65211, 314-882-2002.

**Insects:** Insect problems vary from year to year. At times problems such as the alfalfa weevil, cutworms in corn or green bug in sorghums can reach costly proportions. Timely evaluations of problems such as these are in the best interest of producers. Sometimes the dollar amount of the damage caused by a certain pest may not require application of chemical controls. However, at other times, the pest may exceed an economic threshold if not controlled at the proper time. The appropriate application of insecticides or miticides could mean the difference between a severe loss or a good crop.

Assistance with identification of insect problems and suggestions for control can be obtained from Area Extension Agronomists or Agriculturists in County Extension Centers, and State Extension Entomologists — Dr. Wayne Bailey (Forage, Soybeans, Small

Grains); Dr. Robert Hall (Livestock Insects); Dr. James W. Johnson (Fruit and General); Flernoy Jones (Apiculture, Youth, Public Health and Cotton); Gene Munson (Grain Crops and Stored Grain); and Dr. Darryl Sanders (Household, Structural), Department of Entomology, 1-87 Agriculture Building, University of Missouri, Columbia, Missouri 65211, 314-882-7894. Area Extension Entomologists also can help — Edward Kowalski and Ray Nabors, Delta Research Center, P. O. Box 160, Portageville, Missouri 63873, 314-379-5431.



**SOUTHERN CORN ROOTWORM:** This adult also is called the twelve-spotted cucumber beetle. Primarily a garden pest, its larvae feed on corn roots and more than 200 common weeds, grasses and cultivated crops.

**Diseases:** Plant disease problems occur regularly every year. Some diseases cause inconspicuous but significant losses. Other diseases can reach epidemic proportions, resulting in serious losses. Fungicides, bactericides, and nematicides are chemicals that are strategically used in the control of several diseases. Others are controlled by developing resistant varieties and cultural methods such as crop rotation and sanitation. Since plant diseases are easily confused with many nonparasitic

disorders and insect injuries, it is necessary to have accurate diagnosis.

Assistance with identification of disease problems and evaluation of their impact on crops can be obtained from Area Extension Agronomists or Agriculturists in County Extension Centers and the State Extension Plant Pathologists. They are Drs. Einar W. Palm and Al Wrather, serving respectively, the Department of Plant Pathology, 3-22 Agriculture Building, University of Missouri, Columbia, Missouri 65211, 314-882-3018; and the Delta Research Center, P. O. Box 160, Portageville, Missouri 63873, 314-379-5431.

**Safety:** Numerous questions are associated with the technical and safety aspects of pesticide application. Some of them include:

- Selection and maintenance of application equipment;
- Calibration of the different types of application equipment;
- Handling of pesticide storage, surplus spray, rinsewater and spills;
- The types and proper use of Personal Protection Equipment;
- Pesticide safety and disposal.

Assistance in these areas may be obtained from Area Extension Agricultural Engineers in the County Extension Centers and State Agricultural Engineers — David E. Baker (Safety and Health); Charles D. Fulhage (Agricultural Waste Management); Donald L. Pfost (Soil and Water), Department of Agricultural Engineering, 200 Agricultural Engineering, University of Missouri, Columbia, Missouri 65211, 314-882-2731.

**EXTENSION INTEGRATED PEST MANAGEMENT PROGRAMS:** The University Extension Program integrated its efforts on pest management. Consequently, professors and staffs in the departments of agronomy, entomology, horticulture, plant pathology, agricultural engineering, agricultural

economics and atmospheric science collaborate to provide this integrated approach to plant protection. Operational objectives include:

A. To develop and implement integrated programs that will help prevent or mitigate losses caused by pests (insects and other arthropods, weeds, diseases, and vertebrates) through use of biological, cultural, chemical, and other methods of control.

Activities in the programs include: IPM demonstrations, scouting crops for pests, and teaching IPM concepts; 4-H IPM projects in which farm youths learn to check fields and identify pests on the family farm; and Musk Thistle

IPM using biological control measures involving weevils for aid in control. Other programs include computerization of weather and other data to increase precision in pest evaluations and the prediction of pest occurrences.

B. To develop practical techniques for monitoring pests and beneficial populations. Prediction and monitoring techniques will be developed as research information becomes available.

C. To provide users and advisors with information and training in the principles and applications of IPM. This is accomplished through in-service training, IPM conferences, and distri-

bution of educational materials for growers, scouts, 4-H and vocational-agriculture youth, agrichemical and agribusiness clientele.

For assistance with field crop surveys (scouting), economic surveys, alternative control, pest survey information, pesticide information or other pest management related questions, contact: Dr. Mahlon Fairchild (IPM and Pesticide Coordinator, Entomologist); James H. Jarman (Entomologist); William W. Dierker (Weed Specialist); Henry Mitchel (IPM Computer Specialist), Integrated Pest Management Program, Room 45 Agriculture Building, University of Missouri, Columbia, Missouri 65211, 314-882-7871.

## Recognizing common pests and their damage

Agricultural pests can be divided into six main groups.

- A. Insects and related arthropods (including mites, ticks, millipedes, etc.)
- B. Weeds (broadleaved and grass species)
- C. Diseases of plants
- D. Animal pests (rodents)
- E. Bird pests
- F. Snails and slugs.

The first step in the control of any pest is to identify the problem. You may find some pests that you are unable to identify. Ask your Cooperative Extension Service agent to help you obtain a positive identification.

### **A. Insects and related arthropods**

**1. Insects:** Thousands of different kinds of insects exist. Fortunately, only a few hundred kinds of insects are classified as pests. The way insects may become pests include:

- feeding on leaves (grasshoppers, caterpillars, leaf beetles)
- tunneling or boring in stems, stalks, branches and fruits (corn borers, bark beetles, codling moths)
- feeding on and tunneling in roots (rootworms, wireworms, grubs)

- feeding on seeds (seed corn maggots, meal moths, bean weevils)
- sucking the sap from leaves, stems, roots, fruits and flowers (aphids, leafhoppers, white flies)
- carrying plant disease agents (leaf hoppers, aphids, flea beetles) and
- feeding on man and other animals (fleas, lice, flies).

All adult insects have two things in common — they have three pair of jointed legs and three body regions (head, thorax and abdomen). An insect's growth and development results in change in shape, form and size during the stages of its life. Knowledge of these characteristics will aid in correct identification. Other important features include the wings and mouthparts. Only adults have wings but some adult insects have no wings. Others have two or four wings. Wings vary in shape, size, thickness and structure. Insects cause damage by feeding in one of two ways. Those with chewing mouthparts have toothed jaws that bite and tear the host's tissue. Insects with piercing-sucking mouthparts have a long beak which they force into a plant or animal to suck out fluids or blood.

**2. Mites, Ticks and Spiders:** Mites, ticks and spiders are closely related to insects. The main differences are that the adults have eight

jointed legs instead of six, and have only two body regions. They do not have wings. Although numerous species of mites are agricultural pests feeding on plants, man and animals, as many, if not more, species are beneficial as predators and parasites of other mites and insect pests. Ticks are blood-sucking pests of man and animals. Generally, spiders are considered beneficial since they prey upon insects and other pests.

**3. Sowbugs, Pillbugs and Millipedes:** Sowbugs and pillbugs are closely related to crayfish and shrimp. They have seven pairs of legs and a grayish, segmented, shell-like body covering. Millipedes are hard-shelled, elongated and tubular in shape with at least thirty pairs of legs arranged two pairs per segment. Sowbugs, pillbugs and millipedes are wingless. These organisms, using their chewing mouthparts, may become pests in vegetable crops, greenhouses, or the home garden.

### **B. Weeds**

A weed is defined as "a plant out of place." Weeds compete with crops for soil moisture, nutrients and light, thus reducing yield and in some situations interfering with harvest operations. Weeds are problems as well when they grow along highways, rail-

roads, drainage ditches, in parks, cemeteries and in several other areas. Weeds may affect public health; be poisonous to humans and livestock; and may cause skin irritations, hay fever and allergies of several types. Before you can control weeds, you need to know something about how they grow. One important feature is the length of their life cycle.

**1. Annuals:** Plants with a one-year life cycle are annuals; they may be summer or winter annuals. They grow from seed, mature, and produce seed for the next generation in one year or less and then die. Annuals include both grass and broad-leaf species. Examples of annual grass weeds would include crabgrass, foxtail, fall panicum, etc. Examples of broad-leaf weeds would include pigweed, lambsquarter, cocklebur, jimson weed, velvet leaf, etc.

include winter wheat, some chickweeds, henbit, several mustard species and several wild brome grasses.

**2. Biennial:** Plants that require two growing seasons to complete their life cycle are biennials. They grow from seed and develop a heavy tap root and a compact cluster of leaves (rosette) the first year. During the second year, the plant resumes vegetative growth, produces flowers and seed, and then dies. Examples of biennials include most thistle species (Canada is a perennial), wild carrot, mullen, and others. Biennials are not a serious problem in cultivated crops, because timely tillage will effect control.

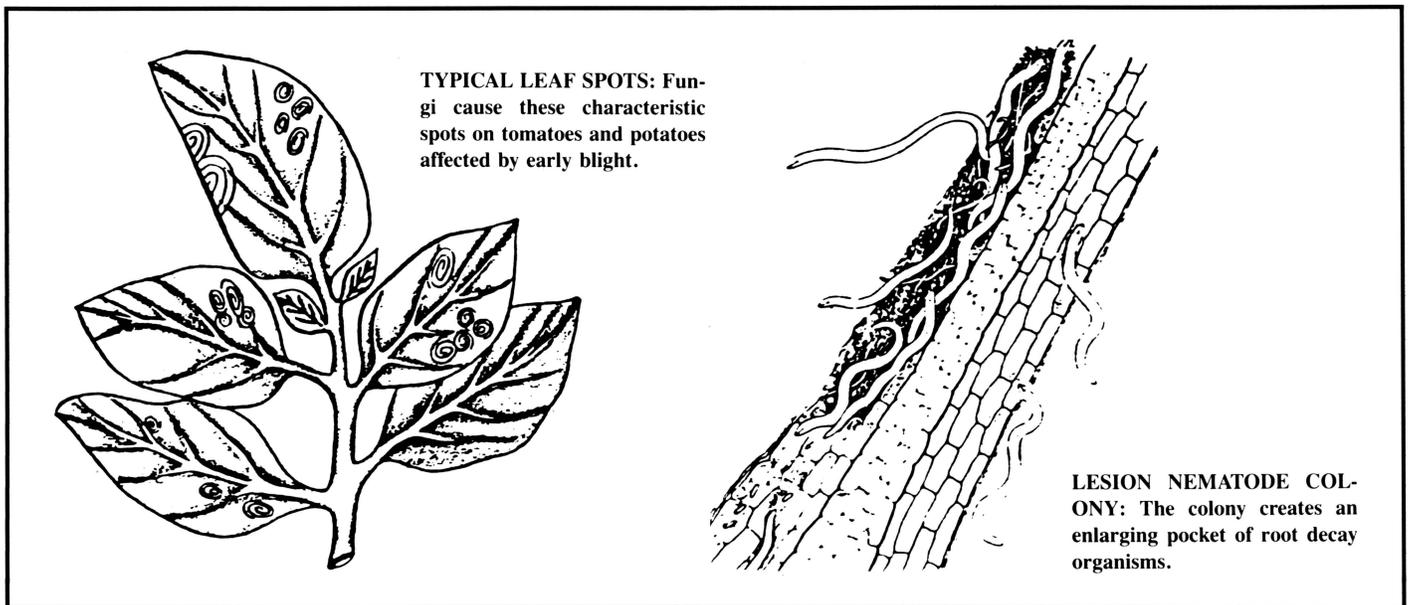
**3. Perennials:** Plants which live more than two years and may live indefinitely are perennials. During the winter, many lose their foliage and the stems of others may die back to the

of our country and have a pronounced effect on cropping practices. Severe outbreaks can have devastating results: the 1845 potato famine in Ireland, caused by late blights; black stem rust on wheat in North Dakota; and, more recently, southern corn leaf blight in Missouri are but a few examples.

A plant disease usually produces some outward sign and/or symptom. There are two kinds of plant diseases.

**1. Diseases Caused by Non-living Agents:** These non-parasitic disorders may be caused by such things as frost, air pollution, drought and toxic chemicals. Such disorders cannot be passed from one plant to another.

**2. Diseases Caused by Living Organisms:** Plant disease is a term usually reserved for those plant problems caused by parasites. The more common group of these parasites include:



(a) Summer annuals are plants that result from seeds which sprout in the spring. These plants grow, bloom, mature, produce seed and die before or with the first frost.

(b) Winter annuals are plants that grow from seeds which sprout in the fall. The seedlings become established, but become dormant with the advent of cold weather. Vegetative growth resumes in early spring, blooms, matures, produces seed and dies by late summer. Examples of winter annuals

ground. They survive the winter not only by the production of seeds, but also by the persistence of underground parts. These parts may be tubers; bulbs; root-like, below-ground stems or above-ground stems that produce roots.

## C. Diseases of plants

A plant disease is any harmful condition that makes a plant different from a normal plant. Plant diseases annually reduce the agricultural output

- fungi
- bacteria
- viruses (including mycoplasmas)
- nematodes
- parasitic plants.

All disease symptoms and signs are a result of an interaction between the host plant, the pathogen, and the environment. A further problem — diseases caused by nematodes — may have no visible above-ground symptoms if soil moisture is adequate.

Some visible ways plants respond to disease causes are:

- galls, swellings, and leaf curls
- stunting, lack of green color, and incomplete development of parts
- blights, leaf spots, wilting, cankers, and rots.

Virus diseases frequently exhibit symptoms of specific patterns on or within the leaves, such as:

- mosaic
- vein banding
- ring spot
- yellows.

From the list of types of parasitic organisms causing plant diseases, nematodes are the only representative from the animal kingdom. Nematodes belong to the Class Nematoda and are commonly known as “roundworms.” This is a tremendously large group of diversified animals. Some are internal parasites of man and animals. Several are parasites of plants, and a majority are free-living in soil humus, decaying plant tissue and fresh water.

Most of the plant parasitic nematodes are microscopic, with the aver-

age length of about one millimeter or less. Plant parasitic nematodes may attack leaves, buds, stems, and root systems.

Practically all of the Missouri nematode problems are caused by species feeding on roots either as ectoparasites (outside) or as endoparasites (inside). Root injury causes above-ground symptoms such as:

- stunting
- yellowing
- loss of vigor
- general decline
- death.

Field injury is rarely uniform, but usually appears as scattered, somewhat oval areas because of spread by cultivation. The two major nematode problems in Missouri are caused by root-knot nematodes on a wide variety of host plants and the soybean cyst nematode on soybeans. General control methods used to reduce nematode losses are:

- sanitation
- crop rotation
- resistant varieties
- fertility management
- nematicides.

## D. Animal pests

Animals such as snakes, turtles, rats and mice, frogs, salamanders and deer may be pests. What may be a pest animal in some cases may be a highly desirable one in others.

## E. Bird pests

A vast majority of birds are insectivorous, especially while rearing their young. Some species become pests when they turn to feeding upon ripening fruit or developing grain such as corn, sorghum, sunflowers, etc. Several bird species, either individually or in flocks, serve as reservoirs of diseases of man and animals. For example, pigeons are carriers of histoplasmosis.

## F. Snails and slugs

Snails and slugs are members of a large group of animals called mollusks. Snails have a hard shell; slugs have no shell. They feed on plant foliage. They are pests in lawns, landscape plantings, greenhouses, and in no-till plantings of corn, sorghums and soybeans.

## The pesticide label

The importance of reading and understanding information included on a pesticide label cannot be overemphasized. Safe application and maximum product performance are prime objectives of label information.

Pesticides vary greatly in their toxicity and environmental risks. This is expressed in hazards to the applicator or to living things in the treated area.

Highly toxic (very poisonous) pesticides have a skull and crossbones with “Danger” and “Poison” printed in bold letters on the label. Moderately toxic pesticides are identified by the word “Warning” in bold letters. Low toxicity products are differentiated from others of higher toxicity by the word

“Caution.” A “Restricted Use” pesticide has those words printed in bold letters at the top of the label.

Selection of the proper pesticide to fit the situation followed by accurate application is essential to satisfactory performance.

Labels list the pests controlled and the rates of application to be used. Deviation from this information is a common cause for failure to solve the problem.

Other information found on the label includes:

1. Brand name, common chemical name, chemical formula, and ingredient statement.

2. Type of formulation (i.e., liquid, or dry), type of pesticide; and net contents.
3. Name and address of manufacturer.
4. Registration number.
5. Precautionary statements, signal words and/or symbols.
6. Reentry statement.
7. Storage and disposal instructions.
8. Use classification.
9. Environmental, chemical and physical hazards.

Read and review UMC Guide 1916 “Pesticide Application Safety.”

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## Applying pesticides correctly

**Selection:** Pesticides are often required to bring a pest species under control or to prevent its buildup. The proper and safe application of a pesticide is the most important aspect of pest control.

Considering the pest needing control, a contact pesticide, a stomach poison, or a fumigant may be more appropriate. Each pesticide has its own unique application requirements. Become familiar with these requirements.

Read and review UMC Guide 1919 "Drift of Agricultural Sprays: Causes" and remember:

The pesticide should be applied at a time to give the best control of the

pest species and in such a manner to prevent drift or contamination to non-target areas.

**Protective Gear, Drift, & Calibration:** Make certain that hoses and nozzles on application equipment are functioning properly before applying the pesticide.

When the temperature is high, some pesticides vaporize and drift to non-target areas. Care should be taken to apply highly volatile pesticides at the proper time of day or when weather conditions are ideal.

Wear protective clothing and equipment indicated or described on the label. Also read and review UMC

Guide 1917 in order to choose and use the proper personal protective equipment.

Calibrate the sprayer with water before using it to apply the pesticide. Read and review UMC Guides 1270, 1271, 1272 and 1273 which deal with the different types of application equipment.

Remove all livestock from the area to be treated and make certain all humans and pets are out of the treatment area, as well.

Apply only the recommended amount of a pesticide. Do not overdose.

Consult the label on the container for precautions or limitations of the product to be applied.

## Pesticide poisoning: Symptoms and procedures to follow in accidents

Most pesticides can cause severe illness or even death if misused. All registered pesticides can be applied safely if used properly. Read and review UMC Guide 1915 "First Aid for Pesticide Poisoning." It is your responsibility to help prevent accidents when pesticides are used:

- By applying and storing pesticides away from children and other untrained persons, and
- By taking care to follow label directions when using them.

Many accidental pesticide poisonings are caused by eating or drinking the product. But mixers, loaders, and applicators may be injured when they inhale pesticide vapor or dust or get a pesticide on their skin.

Most pesticides can and do enter the body through the skin. You may get more toxic material into your body this way than you would by accidentally swallowing or inhaling pesticides while working. With some pesticides, skin contact alone can cause serious illness or death.

Anyone working with pesticides should be feeling well before attempting to mix, load or apply pesticides. Headache, nausea or other symptoms similar to food poisoning or flu may actually be pesticide poisoning; therefore, feeling well before starting a job is very important.

When working with pesticides, always work as a team. No one should mix, load, or apply pesticides alone. If only minor symptoms occur (headache, dizziness), relieve the person immediately. Correct the problem causing the symptoms before allowing someone else to take his or her place.

Illness may occur a few hours after exposure. But, even if symptoms start more than 12 hours after you were exposed to the pesticide, you should check with a poison control center or a knowledgeable physician.

Get medical advice quickly if you or any of your workers become ill during or after pesticide use. If you

think a person may be poisoned, do not leave him alone. Do not let yourself or anyone else get dangerously sick before calling a physician or going to a hospital.

Take the container (or the label) with you. Do not carry a pesticide container in the passenger space of a car or truck. It is better to be too cautious than too late.

Even if you or your co-workers are not victims of acute pesticide poisoning, ignoring safety rules and avoiding the use of recommended personal protective equipment may cause chronic problems at a later time. Recent studies of long term pesticide usage have shown health problems associated with recurring pesticide contact of only one week per year over a career.

For additional information, review UMC Guide 1915, First Aid for Pesticide Poisoning.

### Handling and mixing

Take special precautions to avoid exposure when concentrated materials,

such as wettable powders, dust, or granules are added to the sprayer tank. When you add materials to the sprayer tank, air is forced out and carries some of the pesticide particles with it.

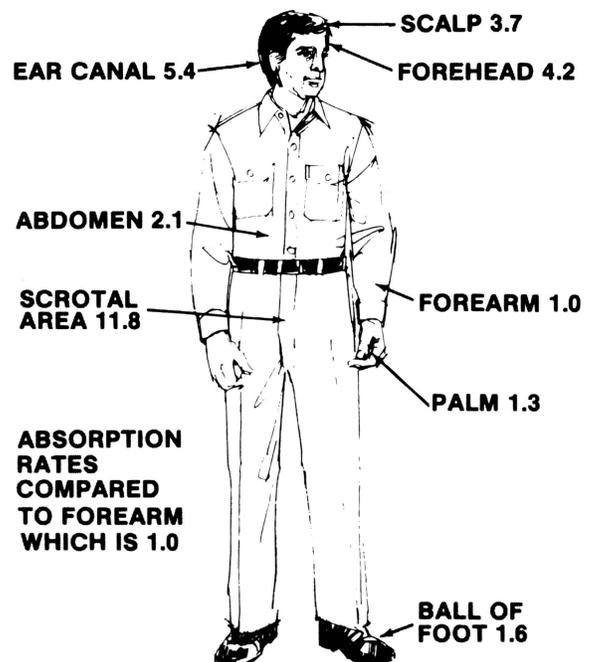
Many types of solvents, some of which are chlorinated, are used in the pesticide formulation processes. Vapors of chlorinated solvents are very dangerous to breathe. They can cause a "high," dizziness, or even unconsciousness. They also can cause permanent damage to the kidney, liver, and nervous system in workers exposed to the vapors for a prolonged time.

Therefore, the applicator should check the pesticide label to be sure he is operating according to label instructions.

### Personal protective equipment for working with pesticides

Pesticides can enter the body through many routes. The most common entry is through skin contact.

**RELATIVE ABSORPTION:** Different parts of the human body absorb chemicals at different rates. In the diagram, 1.0 represents the forearms' absorption rate, the lowest in the body.



The skin on various body parts does not absorb pesticides at the same rate. The figure (page 7) shows dermal absorption rates based on a numerical scale in which the value of 1 for the forearm represents the lowest dermal absorption rate. That value forms the basis for assignment of values to the other body parts.

To prevent dermal (skin) contact and also inhalation of pesticides, applicators should wear protective equipment and clothing.

No safety recommendation can cover all situations. Always read and follow label recommendations on the use of protective equipment and clothing. WEAR IT!!!

## Boots

When handling or applying chemicals, wear unlined, lightweight rubber boots which cover your ankles. Wear trouser legs on the outside so pesticides cannot drain down into the boots. The boots should be washed daily and dried thoroughly inside and out to remove pesticide residues.

## Goggles or face shields

Wear tight fitting, nonfogging chemical splash goggles or a full face shield when pouring, mixing or applying pesticides. Clean the equipment often and make sure the sweatband on the face shield is cleaned since some materials used in sweatbands on face shields absorb and hold chemicals. If possible, wear the sweatbands under the head covering. Eye wear should meet or exceed the current requirements of ANSI (American National Standards Institute; Z87.1, 1968).

## Head and neck coverings

The hair and skin on your neck and head should be protected. Several available types of head gear, such as waterproof rain hats, washable wide brimmed hard or bump hats or caps can be used. Waterproof or repellent parkas will protect the neck and head at the same time. The headgear should not have a cloth or leather sweatband, since these

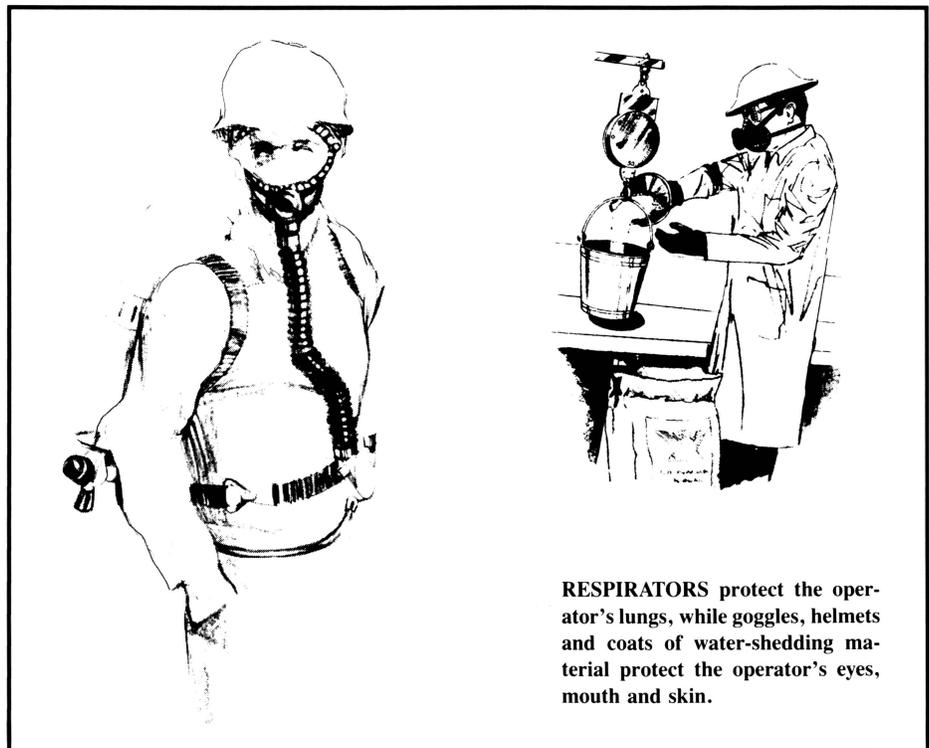
bands absorb chemicals and are difficult to clean, thereby causing continuous and dangerous dermal exposure. Avoid cotton or felt hats since they also absorb pesticides.

## Respirators

Respirators prevent inhalation of toxic chemicals. Wear a respirator when the label calls for it and when applying toxic organophosphates (for example, TEPP, parathion, Guthion, Di-Syston, Thimet, or Phosdrin) or carbamates (for example, Furadan or

### Chemical Cartridge Respirator.

The chemical cartridge respirator is usually a half-face mask, containing one or two "cartridges," which cover the nose and mouth only. The inhaled air which enters the cartridge is pulled through a filter pad and a cartridge of activated charcoal. Use chemical cartridge respirators either for relatively short exposure periods to high concentrations of toxic chemicals or for long exposure periods to low concentrations of toxic chemicals. This respirator should never be used in areas where the oxygen level is too low to



**RESPIRATORS** protect the operator's lungs, while goggles, helmets and coats of water-shedding material protect the operator's eyes, mouth and skin.

Temik). They are especially necessary when handling concentrated, highly toxic pesticides. Workers who will be exposed to small amounts of toxic pesticides constantly for a day or more always should wear a respirator.

Specific cartridges and canisters protect against specific chemical gases and vapors. Be sure to choose the type made to protect you against the pesticides you will use. The respirator must fit the face well to insure a good seal. Long sideburns, a beard or glasses may prevent a good seal.

support life (below 16 percent).

### Chemical Canister Respirator

**(Gas Mask).** Gas masks are designed to protect applicators longer than cartridge respirators. A gas mask usually protects the face better than the cartridge respirator since it covers the entire face (that is, it protects your eyes, nose and mouth). Use a gas mask when you will be exposed to toxic fumes in a high concentration or for a long period of time. Also, wear a gas mask when applying pesticides in enclosed or poorly ventilated areas. As

with the chemical cartridge respirator, a gas mask should never be used in areas where the oxygen level is too low to support life.

**Air Supplied Respirator.** An air supplied respirator should be worn in areas where the oxygen supply is low, where fumigants are used, or where the applicator is exposed to high concentrations of very toxic pesticides in enclosed areas. Fresh air is pumped through a hose to the face mask by a blower from an uncontaminated area

or from a backpack carried by the applicator.

**Care and Maintenance of Respirator.** If breathing becomes difficult during heavy spraying, change the filters in chemical cartridge respirators two or more times a day. Cartridges should be changed after eight hours of use or sooner if you detect pesticide odor. The face piece should be washed with soap and water, rinsed, dried with a clean cloth and stored in a clean dry place away from pesticides. A

tightly closed plastic bag works well for storage.

The useful life of a cartridge or canister depends on the type and amount of chemical fill used in the cartridge, the breathing rate of the wearer, and the temperature and humidity. The manufacturer's instructions on the use and care of the respirator and its parts should be read carefully before the respirator is used. Use only respirators approved by the National Institute for Occupational Safety and Health (NIOSH) or the Bureau of Mines.

## Handling pesticide equipment and chemicals

### Preparing the sprayer

Before a spraying operation is started, rinse out the sprayer; remove and clean all nozzles, nozzle screens, and strainers. Make sure strainers and nozzle screens are 50 mesh or larger when wettable powders are used. All of the nozzles should be of the same type, size, and fan angle for most applications. Check all lines, valves, seals, and the tank after filling the sprayer with water and during calibration to be sure there are no leaks in the spray system. For the operator's safety, replace weather-cracked or worn hoses. Adjust the nozzle height and replace weather-cracked or worn hoses. Adjust the nozzle height and spacing as suggested by the nozzle manufacturer or as specified on the pesticide label. These requirements differ for a given pest or crop.

Only water that is clean enough to drink should be used in the sprayer. A small amount of silt or sand in the water rapidly wears pumps and other parts of the sprayer system.

Operating a pump dry or with a restricted inlet may damage the pump. Do not operate pumps at speeds or pressures higher than the manufacturer recommends. Power take-off pumps should be restrained from rotating by chains or torque bars. Keep all shields in place. Do not use ground speeds that are too high for existing field conditions. Booms bouncing up and down or back and forth can cause

application rates to vary by 50 percent. Also, such bouncing can damage the spray booms or the frame of the sprayer.

### Field applications

Always be aware of the meteorological conditions existing during pesticide application. More spray is lost from a treated area during high winds or low humidity. In Missouri, low wind and high humidity conditions are most prevalent before 10 a.m. and after 6 p.m.

Avoid spraying near beehives, lakes, streams, pastures, houses, schools, playgrounds, hospitals, or sensitive crops whenever possible. If these areas must be sprayed, do not spray during windy or low humidity conditions and always spray downwind from the sensitive area.

If possible, begin spraying in the end of the field that will permit any drift from the sprayer to be blown away from the next area to be treated. Likewise with airblast sprayers, direct the air blast from the sprayer with the prevailing wind and away from the next area to be treated. These two procedures will minimize the amount of pesticide that will be blown onto the operator. Remember, the above are only guidelines and are intended to supplement the good judgment of the pesticide operator.

To minimize drift hazards, use the lowest pressure possible, the lowest

boom height, and the largest spray tips; add thickeners (if the pesticide label permits) in areas where drift is likely to be particularly hazardous. See UMC Guide 1919, Drift of Agricultural Spray, for additional information on reducing drift.

Be alert for nozzle clogging and changes in nozzle patterns. If nozzles clog or other troubles occur in the field, shut the sprayer off and move to an unsprayed area before dismounting from the sprayer to work on it. If nozzles must be cleaned in the field, use a toothbrush or a toothpick for cleaning — never a metal object. A metal object can damage the orifice in the spray tip and significantly alter the spray pattern. We recommend carrying extra spray tips on the sprayer so that plugged tips can be replaced with clean ones. Never try to unclog a nozzle by blowing through it.

Check the pesticide label for re-entry and preharvest intervals. The re-entry interval is the lapsed time after a pesticide application before workers can safely re-enter a field. The preharvest interval is the elapsed time before a pesticide application and harvest of the crop.

### Equipment cleaning and storage

Trained personnel should thoroughly clean the inside and outside of mixing, loading, and application equip-

ment immediately after the equipment is used. People who clean contaminated equipment should wear proper protective clothing, including rubber boots, a rubber apron, goggles, and possibly a respirator. A specific area should be designated for cleaning operations. Use a rack or cement apron with a well designed sump to catch contaminated wash water and pesticides. The cleanup process is important because many chemicals will rapidly corrode some metals and may also react with succeeding chemicals, thus possibly causing a loss of effectiveness.

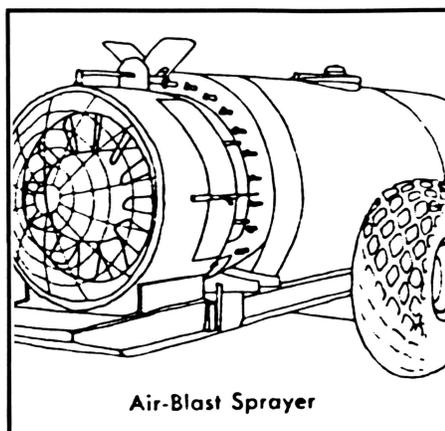
For additional information on cleaning equipment, see UMC Guide 1916, Pesticide Application Safety.

## Disposal of pesticides and containers

To avoid having to dispose of a tank load of the wrong pesticide, check out the job carefully before selecting the pesticide. After you have selected the proper pesticide, mix only enough for the particular job. Preventing a pesticide surplus is the best way to prevent a disposal problem.

Despite your best efforts, however, you cannot always avoid surplus pesticides, and you must take steps to dispose of them properly. If you mix too much pesticide for a job, try to find other areas with the same pest problem and use any extra tank mix or rinse water on these areas. In some cases small amounts of surplus pesticide can be diluted and reapplied to the treated area. Take extreme care to prevent excessive residues, especially with herbicides, by making sure that the total application rate does not exceed the maximum rate for which the pesticide is labeled.

So-called empty containers are not really empty. They still contain small amounts of pesticides, even after they have been properly rinsed. All containers, regardless of their type, should be rinsed three times before disposal. The rinse water should be dumped into the sprayer tank. Otherwise, the rinse water must be treated as a surplus pesticide and disposed of properly. Rinse water should never be dumped



Air-Blast Sprayer

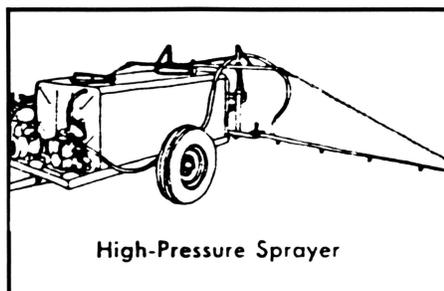
on the ground. Use the following rinse-and-drain procedure to prepare containers for disposal:

1. Empty the container into the spray tank and drain in a vertical position for 30 seconds.
2. Refill the container one-fifth to one-fourth full with rinse water or other recommended solution.
3. Rinse thoroughly, pour into the spray tank and drain in a vertical position for 30 seconds; and
4. Repeat steps 2 and 3 until the container has been rinsed three times.

## Storage of chemicals

Store chemicals in a locked and posted facility where children or other untrained people cannot get to them. Read the labels on pesticide containers for correct storage procedures. Select a storage site high enough that damage from flooding will be unlikely and downwind and downhill from sensitive areas such as houses, play areas, and ponds. Pesticide storage facilities should also be located away from homes and livestock facilities to avoid or minimize contamination in case of fire.

Pesticide and expended pesticide containers are best stored in a separate



High-Pressure Sprayer

building, room, or enclosure, depending on the size of the pesticide inventory.

Sacks, cartons, and fiberboard boxes containing pesticides should be stored on wooden pallets or on shelves off the floor. Securely lock all possible entrances to the storage area. Hang or mount weatherproof signs stating "DANGER — PESTICIDES, KEEP OUT!!" or similar warnings over every entrance to the facility. An exhaust fan for ventilation should be used in storage rooms to reduce the temperature and high concentration of toxic fumes.

An adequate supply of water and detergent or soap is essential in the storage area. We recommend routine use of these cleaning agents by people who work with pesticides or pesticide-related materials or equipment. Also, water is a quick first aid in a poisoning emergency. Materials such as activated charcoal, vermiculite, absorbent clay, pet litter, or sawdust need to be readily available at the storage site to soak up spills and leaks. Hydrated lime and sodium hypochlorite (chlorinated household bleach) can be used to neutralize pesticides in an emergency. A shovel, dust pan, broom, and proper type of fire extinguisher are other essential items.

Do not store pesticides near food for human consumption, animal feed, fertilizer, seed, veterinary supplies, or other stored products. To prevent contamination or to avoid accidentally using the wrong pesticide, store different pesticides in separate locations within the storage area.

Store pesticides only in the original container, with the label plainly visible.

If a pesticide container becomes damaged, transfer its contents to an appropriate container. Label the new container immediately. If possible, attach the manufacturer's label from the damaged container directly to the new pesticide storage container.

# Summary

## Missouri Pesticide Use Act Chapter 281 (October 21, 1976)

### 281.020. DEFINITIONS

(2) "Applicator" or "operator":

(c) "Certified private applicator," any individual who is certified by the director as authorized to use, or to supervise the use of any pesticide which is classified for restricted use for purposes of producing any agricultural commodity on property owned or rented by him or his employer or on the property of another person, if applied without compensation other than trading of personal services between producers of agricultural commodities, on the property of another person;

(e) "Private applicator," any person not holding a certified private applicator's license who shall be required to obtain a permit for the use of any restricted use pesticide for the purpose of producing any agricultural commodity on property owned or rented by him or his employer or on the property of another person, if applied without compensation other than trading of personal services between producers of agricultural commodities.

(13) "Misuse of a pesticide," a use of any registered pesticide in a manner inconsistent with its labeling.

(20) "Private applicator permit," a written certificate, issued by the director or his authorized agent, authorizing the purchase, possession or use of certain restricted use pesticides by a private applicator:

### 281.040. PRIVATE APPLICATOR, RESTRICTIONS ON — CERTIFICATION REQUIREMENTS — TERM OF LICENSE — RENEWAL WITHOUT CHARGE.

1. No private applicator shall use any restricted use pesticide unless he first complies with the requirements, determined pursuant to subsection 2 or 5 of this section, as necessary to prevent unreasonable adverse effects on the environment, including injury to the applicator or other persons, for that specific pesticide use.

2. The private applicator shall qualify for a certified private applicator's license by attending a course of instruction provided by the director on the use, handling, storage and application of restricted use pesticides. The content of the instruction shall be determined and revised as necessary by the director. Upon completion of the course, the director shall issue a certified private applicator's license to the applicant. The director shall not collect a fee for the issuance of such license.

3. A certified private applicator's license shall expire five years from date of issuance and may then be renewed without charge or additional fee. Any certified private applicator holding a valid license may renew that license for the next five years without additional training unless the director determines that additional knowledge related to the use of agricultural pesticides makes additional training necessary.

4. If the director does not qualify the private applicator under this section he shall inform the applicant in writing of the reasons thereof.

5. The noncertified private applicator may apply to the director, or his designated agent, for private applicator permits for the emergency purchase of restricted use pesticides. When the noncertified private applicator has demonstrated his competence in the use of the pesticides to be purchased on any emergency basis, he shall be issued permits for the emergency purchase of restricted use pesticides. The director or his designated agency shall not collect a fee for the issuance of such permit.

### 281.105. VIOLATIONS A MISDEMEANOR.

1. Any person who violates any provision of sections 281.010 to 281.130\* shall be guilty of a misdemeanor and upon conviction, shall be punished by a fine or not more than \$500.00.

2. Any person who knowingly violates any provision of section 281.010 to 281.130\* shall be guilty of a misdemeanor and, upon conviction, shall be fined not more than \$5,000, and may be imprisoned for not more than one year, or both.

3. Any person who misuses any pesticide or falsifies any record required by sections 281.010 to 281.130\* shall be guilty of a misdemeanor and, upon conviction, shall be fined not less than \$100.

4. Any person who knowingly misuses any pesticide or knowingly falsifies any record required by sections 281.010 to 281.130\* shall be guilty of a misdemeanor and, upon conviction, shall be fined not less than \$500 and not more than \$5,000, and may be imprisoned for not more than one year, or both.

## A Summary of the Rules Promulgated; by Authority of the Missouri Pesticide Use Act

### 2 CSR 70-25.010. DEFINITIONS

(1) Act: Missouri Pesticide Use Act.

(2) Agricultural commodity: Any plant, or part thereof, animal, or animal product produced or being produced by a person primarily for sale, consumption, propagation, or other use by man or animals. (Producers of an agricultural commodity include farmers, ranchers, vineyardists, plant propagators, Christmas tree growers, aquaculturists, floriculturists, orchardists, foresters, sod producers, or other comparable persons.)

(3) Direct supervision or directly supervised by: The act or process whereby application of a pesticide is made by a competent, noncertified applicator acting under the instructions and control of a certified applicator, certified operator or private applicator with a permit who is responsible for the actions of the noncertified applicator, and who is available, if and when needed, even through such certified applicator, operator or permittee is not physically present at the time and place the pesticide is applied. These terms require, at minimum, that:

(A) The certified applicator, operator or private applicator with a permit and the noncertified applicator work out of the same physical office; and

(B) The certified applicator, operator or private applicator with a permit assures that the noncertified applicator is given written instructions for each job, which instructions shall include the name and address of the person on whose property the pesticide is to be applied, the pests sought to be controlled by application, and the pesticide to be applied; and,

(C) The certified applicator, operator or private applicator with a permit know the whereabouts of the noncertified applicator while the noncertified applicator is engaged in applying pesticides; and

(D) The certified applicator, operator or private applicator with a permit be available by phone, radio, or in person, when the noncertified applicator may have a problem with a pesticide application and be near enough to the site of application to take care of an emergency if one occurs; and

(E) The certified applicator, operator or private applicator with a permit when required by the pesticide label shall be physically present when application is made by a noncertified applicator.

### 2 CSR 70-25-030 CLASSIFICATION OF LICENSES.

(1) Pesticide applicator or operator licenses.

(C) Certified private applicator license.

1. A certified private applicator license shall be obtained by those individuals who apply restricted use pesticides as a private applicator as defined in section 281.020(2)c. RSMo (Supp. 1977).

#### **2 CSR 70-25.050 REVIEW OF CERTIFICATION OF LICENSE**

(3) Additional training of certified private applicators shall be required within five (5) years from initial certification and within each subsequent five-year period. Such training shall pertain to maintaining competence and meeting the needs of changing technology in the safe and proper use of agricultural pesticides.

#### **2 CSR 70-25.130. REQUIREMENT FOR A CERTIFIED PRIVATE APPLICATOR LICENSE**

(1) A certified private applicator license will be issued to any private applicator who meets the following requirements:

(A) Applicants shall submit to the director a verification of training signed by the applicant and an authorized pesticide trainer.

(B) The applicant shall have attended a private applicator training program provided by the director, and presented by the University of Missouri Cooperative Extension Service, or the applicant shall have demonstrated competence in the safe and proper use of pesticides by completing any other program of pesticide training approved by the director.

#### **2 CSR 70-25.150. COURSE OF INSTRUCTIONS AND STANDARDS OF COMPETENCE FOR CERTIFIED PRIVATE APPLICATORS**

(1) Certified private applicators shall attend a course of instruction approved by the director as required by section 281.040 RSMo (Supp. 1977). The course of instruction shall encompass the standards of competence as provided in section (2) of this rule. Private applicators shall be instructed as to the general pest problems and general pest control practices associated with agricultural operations, proper storage, application, handling and disposal of pesticides and pesticide containers, and the legal responsibilities of private applicators.

(2) Standards of competence:

(A) The recognition of common agricultural pests and the recognition of the damage caused by these pests.

(B) The reading and understanding of the label and labeling information, including the common name of the pesticide; the pest to be controlled; timing and methods of the application of the pesticide; safety precautions; preharvest intervals; re-entry intervals and disposal procedures for pesticides and pesticide containers.

(C) The application of pesticides in accordance with label and labeling instructions and warnings, including the ability to prepare the proper concentration of the pesticides to be used under particular circumstances, taking into account such factors as the area to be covered, speed at which application equipment will be driven, and the quantity to disperse in a given period of operation.

(D) The recognition of local environmental situations that must be considered during application to avoid contamination.

(E) The recognition of poisoning symptoms, and procedures to follow in case of a pesticide accident.

(3) Attendance of an approved course of instruction by the private applicator shall be verified by the signature of the instructor and the signature of the private applicator on a verification document provided by the director. Such document shall be forwarded to the Missouri Department of Agriculture as proof of attendance. Upon receipt of the document of verification of attendance, the director shall forward to the private applicator a certified private applicator license.

## **Some Major Amendments to FIFRA in 1978 Which Impact the Private Applicator (Farmer)**

The "Federal Pesticide Act of 1978" provides for significant changes in the law regarding the application of pesticides. Greater flexibility in pesticide use is permitted. Certain provisions allowed by the new law include:

1. Application at less than labeled rate (dosage, concentration or frequency) is permitted.

2. Application for control of nonlabeled pests is permitted (providing that site is labeled and the labeling does not specify only for specific pests).

3. Application by any method is permitted unless specifically prohibited by the labeling (aerial, ground, etc.).

4. Mixing pesticides with fertilizers is permitted unless specifically prohibited by the labeling.

5. Pest Control Operators are not to be considered sellers or distributors of the products which they utilize in the normal conduct of their business.

Although qualified, independent persons can recommend these practices at variance with Federally registered labeling as outlined in the new amendments, the position of the Missouri Department of Agriculture and the Cooperative Extension Service personnel in Missouri will be to continue recommending pesticide use in strict accordance with the label. Users and applicators will be allowed to apply pesticides on the basis of the amendments, following common sense, thoughtful analysis of each situation, and careful discretion.

The Act also provides that states may elect to carry out primary enforcement responsibilities. The State of Missouri has elected this responsibility which is carried out by the Missouri Department of Agriculture.

Amendments to that section of the law covering pesticide registration should provide for more registered products entering the marketplace.

The EPA is authorized to pay up to 50% of the costs for state training and certification programs.

The EPA is authorized to restrict pesticide uses by regulation as well as through the full registration process.

The EPA was directed to investigate methods of ultra low volume application and make recommendations. The Agency published an advisory opinion on March 3, 1981, which allows such application based upon written or published recommendations by the extension service or appropriate federal, state, or local government agencies. No such recommendations are presently in effect in Missouri. Contact the Cooperative Extension Service or State Department of Agriculture for updated information.