

## The Oklahoma Cooperative Extension Service Bringing the University to You!

The Cooperative Extension Service is the largest, most successful informal educational organization in the world. It is a nationwide system funded and guided by a partnership of federal, state, and local governments that delivers information to help people help themselves through the land-grant university system.

Extension carries out programs in the broad categories of agriculture, natural resources and environment; family and consumer sciences; 4-H and other youth; and community resource development. Extension staff members live and work among the people they serve to help stimulate and educate Americans to plan ahead and cope with their problems.

Some characteristics of the Cooperative Extension system are:

- The federal, state, and local governments cooperatively share in its financial support and program direction.
- It is administered by the land-grant university as designated by the state legislature through an Extension director.
- Extension programs are nonpolitical, objective, and research-based information.

- It provides practical, problem-oriented education for people of all ages. It is designated to take the knowledge of the university to those persons who do not or cannot participate in the formal classroom instruction of the university.
- It utilizes research from university, government, and other sources to help people make their own decisions.
- More than a million volunteers help multiply the impact of the Extension professional staff.
- It dispenses no funds to the public.
- It is not a regulatory agency, but it does inform people of regulations and of their options in meeting them.
- Local programs are developed and carried out in full recognition of national problems and goals.
- The Extension staff educates people through personal contacts, meetings, demonstrations, and the mass media.
- Extension has the built-in flexibility to adjust its programs and subject matter to meet new needs. Activities shift from year to year as citizen groups and Extension workers close to the problems advise changes.

The Cooperative Extension Service does not endorse any of the products referred to herein. Names given represent commonly available sources for these type products. Always read the label of any pesticide before it is used. Prior to using pesticides, nursery and greenhouse growers must be sure that they are in compliance with all federal and state statutes governing the use of pesticides. Pesticide applicators are ultimately liable for any injury or death to persons or damage to the environment due to negligence. The literature above was prepared to serve as an outline for pesticide safety and thus is not intended to be comprehensive, nor is it a substitute for proper training.

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## Pesticide Use and Safety in the Nursery and Greenhouse

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### Toxicity and Labels

Pesticides are poisons, both in name (icide=to kill) and fact. They can enter a body through the skin (dermal poisoning), the eyes (ocular poisoning), be swallowed (oral poisoning), or be inhaled (respiratory poisoning). The toxicity of a pesticide is usually expressed in parts per million (ppm) or milligrams per kilogram (mg/kg) of body weight. The "LD50" number represents the dosage which will kill 50 percent of the test animals (rats). Pesticide LD50 numbers are measured for either oral or dermal exposure. The higher the number, the less toxic the product. The lower the number, the greater the toxicity. Refer to the table on page 6 for toxicity measures and warnings. Also obtain Extension fact sheet EPP-7457 for a detailed account of toxicity of pesticides.

The label is a quick way to learn about the toxicity of a pesticide. Highly toxic pesticides, which should be handled with extreme care, will display a skull and crossbones in addition to the signal words "DANGER-POISON." Moderately toxic pesticides will state "WARNING" on the label and slightly toxic products will be labeled "CAUTION." All labels will bear the words "KEEP OUT OF REACH OF CHILDREN."

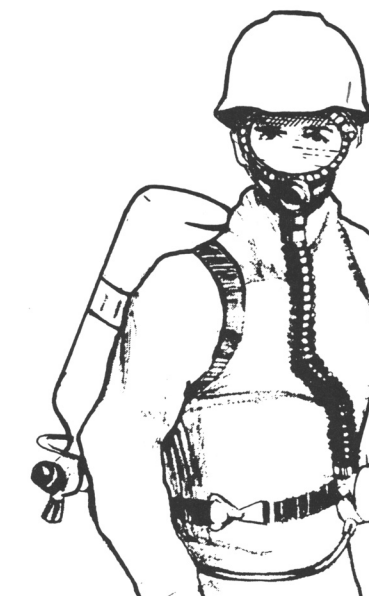
### Application

To protect yourself, read and follow all label directions and safety precautions. Do not apply more or less pesticide than the label states. Overdosage is wasteful, expensive, and illegal! Use of a pesticide at less than label rates is also illegal in Oklahoma. There may be several registered products with the same active ingredient. Be sure the product you choose has the application site and/or crop listed on the label. If it does not list a target pest for a given crop, contact your local Cooperative Extension Educator for advice.

### Spray Adjuvants

Besides the pesticides themselves, adjuvants can magnify the risk of bodily contamination. A spray adjuvant

Oklahoma Cooperative Extension Fact Sheets  
are also available on our website at:  
<http://osufacts.okstate.edu>



is a substance added to another substance to increase the efficiency of the other substance. Several spray adjuvants are used in horticultural production such as spreaders, stickers, activators, foam suppressants, and wetting agents. These adjuvants may heighten dermal absorption and exposure to a pesticide, causing increased incidence of skin rashes and irritation. Each person who applies a pesticide solution containing an adjuvant should be aware of this possible problem.

Read the label to see if the pesticide you are using already contains an adjuvant. Many emulsifiable and liquid products used on ornamentals already contain adjuvants.

### Storage

Unsafe pesticide storage can lead to serious accidents. Read the label for specific storage recommendations. Your storage areas should be clean, cool, dry, well-lighted, and well-ventilated. The floor should be constructed on a non-absorbent material, or have a sealant applied to prevent possible contamination of the floor. Absorbent materials such as clay, kitty litter, activated charcoal, vermiculite, sawdust, or the new super-absorbent, gelatin-like products should be stored on the premises to soak up spills. Dispose of contaminated materials

properly. Placing containers of pesticides in plastic buckets or plastic pans can be an inexpensive and easy containment system to prevent spills.

Store pesticides in their original containers and not in hot (90°F or more) or cold (40°F or less) areas. Mark the purchase date on each container. Keep combustible materials away from steam pipes and heat sources. Note flammability precautions on labels and material safety data sheets (MSDS) and store accordingly. Store highly toxic pesticides together and store herbicides separately from all other pesticides.

Do not leave the products where children, customers, or animals can accidentally come in contact with them. Be sure the storage area is clearly marked “DANGER, POISON, PESTICIDE STORAGE—KEEP OUT” on all exterior sides with water-repellent ink that is readable at 20 feet. Keep the storage area locked at all times.

Post the Oklahoma Poison Control Center telephone numbers in a conspicuous place on the premises. Also, include the telephone numbers of the local emergency room, physicians, and fire department.

Post an inventory of your pesticide storage just inside the facility or on the storage room door. Provide the emergency personnel (fire and police department) with a copy of the inventory, labels, and MSDS with the names of contact persons. Keep a copy of the inventory, labels, and MSDS on file in the office. Read the labels and MSDS before you use the chemicals. Follow any other Right-to-Know laws of your state.

A floor plan of the building which shows the location of the pesticide room and other chemicals stored should be available to the local fire department. In the event of a fire, the fire department can use this information to better protect their personnel and the public from toxic chemicals.

For additional information on pesticide storage, please refer to Extension fact sheet EPP-7451.

## Disposal

Always be certain that pesticides are labeled since it is illegal to dispose of unknown pesticides. Dispose of all torn and/or leaking containers of old or unused products. Contact the Oklahoma Department of Agriculture, Food and Forestry (ODADFF) or local Extension Service office for proper disposal of pesticides. Never reuse an empty pesticide container. For current state regulations on pesticide disposal, consult ODAFF or the local Cooperative Extension office.

Proper disposal of pesticides is an important phase of pest control. Improper disposal of products can be hazardous to people and the environment. Triple rinse a liquid pesticide container when it is emptied: fill the container about one-third full and swish the diluent around the container. Allow the container to drain well between each rinse (30 or more seconds). Triple-rinsed containers are considered nonhazardous. Containers can be disposed of in an approved sanitary landfill. Non-glass containers should be punctured and crushed before disposal. Rinse material should be poured into the spray tank. A pressure rinse device is quicker and more efficient by rinsing containers via pressure. If an empty, triple-rinsed container cannot be disposed of immediately, store it in a safe, locked area. Before disposing of containers that held powders or granular pesticides, be sure all material has been removed from the containers. All containers are to be punctured after rinsing according to Oklahoma law.

To eliminate disposal problems, plan ahead in preparing spray mixtures! Purchase the kind and amount needed. Mix only the amount of pesticide needed to do the job. Clean equipment immediately after use. Be sure rinse water is not disposed of in a manner that may contaminate the environment. The best procedure, presently, is to apply the rinse water to a site/crop on the pesticide's label. The equipment and clean-up area should not be accessible to children, pets, or unauthorized individuals.

## Safety Equipment

There are two categories of PPE to protect against pesticide exposures. PPE requirements for early-entry workers is different than those for pesticide handlers and applicators. Applicators must wear PPE specified on the product label for “pesticide applicators and handlers.” PPE for early-entry workers is specified in the “Agricultural Use Requirements” box on the label. Always have at least five-gallons of clean, fresh water and a squeeze container of liquid dish detergent available at any pesticide application site. A portable eye wash should be available, too. These should be present in case of an accident so that a pesticide can be washed off the applicator or the eyes rinsed immediately upon exposure. However, to cut down on the risk of exposure, proper safety equipment should be worn. Always refer to the label and MSDS for recommendations on minimum amount and kinds of personal protection equipment (PPE) to be worn.

### Gloves

Safety gloves should be made of chemical-resistant material and be free of holes and tears. Gloves should be unlined to prevent contamination of the inside portion. Read the label for specific recommendations. Some labels specify glove materials. Wear gloves tucked inside sleeves if spraying downwards. Wear them outside sleeves only if spraying upwards, with the end of the gloves folded into a half-inch cuff to prevent pesticides from running onto wrists and arms, as when spraying hanging baskets. Replace worn or damaged gloves; keep several pairs of gloves available. To prevent contamination of hands, wash gloves with detergent and water before removing the gloves. After removing gloves, wash hands with detergent and water. Cotton or leather gloves should not be used in applying pesticides because they cannot be cleaned.

### Boots

Boots should also be made of a chemical-resistant material. Again, read the label and MSDS for any specific recommended materials. Be sure that boots are worn inside the pant legs. Wash and dry the boots after each use. Care should be taken in selecting boots to avoid sole surfaces that may increase hazards from slippage. Cloth, canvas, and leather foot wear should be worn only when chemical resistant boots are worn over them. Cloth, canvas, and leather cannot be cleaned to remove all possible pesticide residues.

### Coveralls

Clothing of tightly woven fabrics can be properly used for PPE. However, it is best to change from these clothes into clean clothes after application and launder the PPE. In general, natural fibers will “collect” and trap spray particles

better than synthetic fibers. If synthetic fibered materials are washed a number of times before clothing is worn, the threads will fray and will "collect" and trap spray particles better than new synthetic fabric. The key is tightly woven fabric.

Wear clean and dry overalls, made of Tyvek, Goretex, or similar material, which cover the entire body from the neck down, when applying pesticides. Disposable coveralls may only be washed for a limited number of times. Check product information sheets for washing instructions. All safety clothing is to be stored and washed separately from other clothing. Washing should be done on a full load cycle in 140°F water with a high phosphate soap. After pesticide-soiled clothing has been laundered, run another wash and rinse cycle through the machine. Air dry all clothing; do not use a dryer.

Research has shown that clothing contaminated with concentrated pesticides may remain contaminated even after repeated washings. If any clothing is contaminated with a concentrated pesticide, dispose of it immediately.

When using methyl bromide fumigant, do not wear rubberized protective clothing. Methyl bromide can penetrate rubber; if prolonged skin contact occurs, severe blistering can result.

### Head and Neck Coverings

A waterproof, wide-brimmed chemically resistant hat/cap should be worn by all pesticide applicators. Avoid hats with cotton or felt bands, because the bands may absorb chemicals. Wash head gear after each use.

### Goggles or Face Shield

Eye protection is extremely important when working with chemicals. Wear a full face shield that attaches to a hard hat or eye goggles that are ventilated to prevent fogging. Be sure that eye protection is worn during preparation as well as the spraying of the mixture and cleaning. Headbands of goggles also should be made of non-absorptive material.

### Respirators (Cartridges and Gas Masks)

Read the pesticide label and MSDS to determine what type of respiratory protective gear you should wear. Respirators prevent you from inhaling fumes. Wear them during any potential pesticide exposure and, especially, when mixing concentrates and during application.

Wear cartridge respirators, which have either one or two cartridges to filter pesticide fumes, vapors, etc., to cover the nose and mouth or full face when applying pesticides other than fumigants. Cartridges should be changed after eight hours of use, per instruction, or whenever pesticide odors are detected. Organic vapor cartridges may be used for pesticides; however, it is best to use cartridges that are listed for pesticides. Gas mask respirators cover the entire face, including the eyes. They have an attached canister that has a greater capacity for absorbing toxic fumes than cartridge respirators. Wear this type when working with fumigants or when heavily concentrated fumes are present. You must match the canister with the pesticide or the canister will not provide protection. Always use special fumigant masks for extremely toxic materials such as methyl bromide. Do not use ordinary chemical cartridge respirators for fumigants. All respirators are to be approved by the National Institute for Occupational Safety and Health (NIOSH) and Mine Safety and Health Administration (MSHA). Look for the NIOSH approval numbers beginning with the letters "TC."

### How to Use Respirators Safely

1. Read the label on the pesticide container. Note safety equipment recommended.
2. Read the label on the respirator cartridge or gas mask canister. Be sure the chemical filter will provide protection against the pesticide you intend to use.
3. Make sure all valves, mechanical filters, and chemical filters (cartridges or canisters) are properly positioned and sealed.
4. Fit the respirator on your face to insure a tight but comfortable seal. Respirators cannot be worn with beards. Some respirators cannot be worn with eyeglasses. In some situations, some respirators cannot be worn with contact lenses.
5. Test for air leakage by placing your hand over the outside exhaust valve. Exhale to cause slight pressure inside the facepiece. With the cartridges on, do the same test for the intake valve. If air escapes, re-adjust the headbands until a tight seal is obtained. Also do an inhale test and odor test by purchasing fit test kits.
6. Change filters whenever any leakage is detected by smell, taste, or irritation to eyes, nose, or throat, or when breathing becomes difficult. Leakage could be occurring from other areas besides the filters. If nausea, dizziness, or signs of distress develop, get to fresh air immediately. Also, when the applicator senses that the inhaled air becomes uncomfortably warm, this could indicate a spent filter.
7. As a fundamental rule of safety, never use a cartridge for more than eight hours.
8. After each use of the respirator, remove all mechanical filters and wash the mask with soap and warm water. Do not wash chemical filters. Rinse the mask thoroughly with clean water to remove all traces of soap. Wipe it with a clean cloth and allow it to air dry in a clean and well-ventilated area.
9. Store the clean respirator mask, cartridges, canisters, and mechanical filters in a clean dry place, preferably in a tightly sealed plastic bag. If the canister cannot be resealed, then dispose of it.
10. **Warning:** If you have a respiratory impairment or have trouble breathing when wearing a respirator, do not attempt to work when a respirator is required.
11. Do not rely on filters or cartridges to supply oxygen. They should not be used where oxygen may be deficient.
12. All equipment must be regularly inspected to ensure its proper working order.
13. A worker must have an exam by a physician before using a respirator.

### Testing for Exposure for Pesticides

Cholinesterase is an enzyme necessary for the proper function of the nervous system in humans and mammals. Carbamate insecticides (Sevin/carbaryl, etc.), organophosphates (malathion, diazinon, etc.) and many other natural and synthetic chemicals interfere with the action of cholinesterase.

A base line for the enzyme must be established before a person begins working with organophosphate or carbamate insecticides. By developing a base line for each person, weekly or bi-weekly tests can aid in identifying persons who may have been or are being overexposed to these insecticides.



It is important for each person to be tested because of individual differences in cholinesterase levels. Any overexposed person should be removed from potential exposure until cholinesterase levels return to normal. Such detection also allows one to reevaluate the safety program in the nursery or greenhouse. It may not be feasible to test if carbamates are the only insecticides used because of the rapid recovery of cholinesterase levels.

If an applicator uses carbamate and/or organophosphate insecticides regularly, he/she should take a blood test to measure pseudocholinesterase and/or Red Blood Cell (RBC) acetylcholinesterase enzyme activity. This is a simple blood test that can be taken at many hospitals. The test establishes the base line for the enzyme so that, if pesticide poisoning is suspected, another blood test can be performed for confirmation. The best time to establish the base line is prior to the major spray season, or when there has not been any exposure to these pesticides for three to four weeks. Discuss this with your physician beforehand to ensure that the medical facility can conduct the test and that results can be accurately interpreted.

## Employee Training

### Regular Checking

Set aside time to check with employees regularly on any concerns or questions they have on pesticide application. Also, this is a good time for the person in charge to relay any newly acquired information on pesticide application. Take this time to review safety procedures and stress safety. The nursery or greenhouse business may want to purchase instructional videos, which are often available in non-English versions. These videos could be periodically viewed by workers and would help to reinforce good pesticide work habits.

Never eat, drink, or smoke while mixing or applying pesticides. Food, water, or tobacco products contaminated with pesticides can create a high risk of entry of the chemical into the body. Keep all food and beverages away from pesticide storage areas and do not eat in pesticide-treated areas. Managers should designate a break area where workers can relax.

### Precautions

Alerting workers to the various ways pesticides may enter the body is an excellent measure to prevent accidental poisonings, but it is often overlooked.

**Dermal**—About 97% of all body exposure to pesticides occurs on the skin. This occurs from mixing, applying, cleaning, disposing, and contacting pesticide residues on plants. Different parts of the body skin vary in their susceptibility or ability to absorb pesticides. Dermal contact can occur as a result of wearing inadequate protective clothing and equipment, wearing pesticide-contaminated clothing, splashing or spraying chemicals on unprotected skin and failing to wash hands after handling pesticides or their containers.

**Inhalation**—Once inhaled into the lungs, pesticides can quickly enter the bloodstream. Also, the nose, throat, and lungs may be damaged in the process. This type of poisoning may be caused by accidentally breathing vapors from fumigants and other toxic substances, exposure to pesticides as a result of closed or poorly ventilated area or breathing in contaminants as a result of not wearing appropriate protective gear.

**Oral**—The best way to prevent oral poisoning is to never put pesticides into unlabeled containers which may be mistaken for food or drink. People also have been poisoned because of careless smoking and eating habits, or using the mouth as a siphon. Additionally, people sometimes fail to wash their hands after handling pesticides or containers.

**Eyes**—Eyes have a large surface area and can quickly absorb a large quantity of pesticide. Always protect the eyes against splash or drift. Workers must also concentrate to avoid rubbing their eyes while applying pesticides or afterwards before their hands are thoroughly washed during cleanup.

### Accidents

Always let someone know when you plan to apply a pesticide. Particularly high risk situations are fumigating greenhouses where proper air ventilation is absent.

If you suspect that an employee has been poisoned by a pesticide, follow the label for first-aid advice and immediately call a physician. Refer to Extension fact sheet EPP-7453 for an overview of first aid procedures.

Take the pesticide label and MSDS with you to the physician since they will be needed to determine proper treatment.

If pesticide is spilled on a worker, remove contaminated clothing immediately and wash the skin thoroughly with soap and water, but avoid an abrasive cleaner which may allow the chemical to penetrate the skin. It is important that an eye wash and shower are within access in case of accidental spills or splashing to the eyes. Move a worker overcome by vapors to fresh air. Be prepared to render artificial respiration if breathing stops. It is a good idea to be certain there is at least one employee trained in CPR.

### Worker Protection Standard

Greenhouse and nursery production areas come under EPA's Worker Protection Standard (WPS). All pesticide labels as of October 25, 1995 will have references to WPS. Specifically, greenhouse/nursery growers should observe the personal protective equipment, restricted-interval, definition of treated areas, and other WPS requirements which will be on or referenced to on the label.

Employers should conduct safety training for pesticide handlers before the greenhouse season commences. Criteria that has to be covered during such training can be found in The Worker Protection Standard for Agricultural Pesticides — How to Comply. Before applying any pesticides, employers need to establish decontamination sites, conduct safety training for pesticide handlers, acquire PPE for the employees, and determine a centralized and prominent location to display pesticide information. For example, a pesticide application list should include:

- location and description of areas to be treated,
- time and date the pesticide is scheduled to be applied,
- product name, EPA reg. no. and active ingredient(s)
- restricted-entry interval for the pesticide emergency information, including the name, phone number, and address of the nearest emergency medical facility.

WPS information material can be obtained from any County Extension Office or from the local Department of Agriculture, Food and Forestry Inspector.

### Certification

Nurserymen or greenhouse growers, who apply restricted use pesticides to their own or rented property and who are producing an agricultural commodity in the greenhouse or nursery, are certified in Nursery Greenhouse category (3c) as a non-commercial applicator. If the person applies any

pesticide for hire or compensation, the person must be certified in the Nursery Greenhouse category (3c) as a commercial applicator. Contact your local Cooperative Extension Office or the Oklahoma Department of Agriculture, Food, and Forestry for information.

#### Poisonings:

Oklahoma Poison Control Center  
1-800-522-4611  
National Pesticide Telecommunications Network  
1-800-222-1222

#### Spills:

National Response Center  
1-800-424-8802  
Department of Environmental Quality Hotline  
1-800-522-0206  
CHEMTREC  
1-800-424-9300  
Pest Management Section, Dept. of Agriculture  
405-521-3864

## Acute Toxicity Measures and Warnings

Categories	Signal Word Required on the Label	Categories of Acute Toxicity			Probable Oral Lethal Dose for 150 lb person
		LD50	LD50	LC50	
		Oral mg/kg	Dermal mg/kg	Inhalation mg/l	
<b>I Highly Toxic</b>	DANGER POISON skull and crossbones	0-50	0-200	0-2,000	A few Drops to a teaspoonful
<b>II Moderately Toxic</b>	WARNING	50+ to 500	200+ to 2,000	2,000+ to 20,000	Over one teaspoonful to one ounce
<b>III Slightly Toxic</b>	CAUTION	500+ to 5,000	2,000+ to 20,000	—	Over one ounce to one pint or one pound
<b>IV Relatively Non-Toxic</b>	CAUTION	5,000+	20,000+	—	Over one pint or one pound