

## Pesticide Safety and Personal Protective Equipment for Citrus Grove Workers<sup>1</sup>

---

Brian Boman, Darren Cole, Steve Futch, Ward Gunter, Jack Hebb, Chris Wilson<sup>2</sup>

### Names, Classification and Toxicity of Pesticides

The chemical names of pesticide active ingredients are usually so long and complex that they are generally used only in the active ingredient statement on the pesticide label and in scientific or technical publications. The common name of a pesticide active ingredient is one that is commonly used and has usually been approved by an appropriate scientific group. The trade name of a pesticide active ingredient is a copyrighted name used by its producer. A pesticide active ingredient will usually have only one common name but it may have several trade names. For example, glyphosphate is the common name for the chemical name isopropylamine salt of N-(phosphonomethyl) glycine, the active ingredient in Roundup®. Trade names should not be confused with the brand names used by formulators and distributors of pesticide products.

Insecticides, herbicides, fungicides and other pesticides are primarily classified on the basis of their chemical structure or origin. The inorganic pesticides

are those which contain no carbon in their chemical structure. The organic pesticides, those that contain carbon, are usually synthetic but some are obtained from natural sources such as plants or microorganisms. Some synthetic organic pesticides such as the pyrethroids, or synthetic pyrethrins, are based on naturally occurring chemicals.

The Environmental Protection Agency (EPA) uses the results of acute (short term) toxicity studies on test animals, usually rats and rabbits, to place pesticides in toxicity categories (I-IV) (one-four) which determine what signal word must appear on the label. Although inhalation toxicity, eye corrosiveness and skin corrosiveness studies are also used, results of acute dermal and acute oral toxicity studies are more publicized and usually more important.

The table at the end of this document shows the signal words that must appear on the pesticide label for each toxicity category and the range of the oral and dermal median lethal doses (LD50) for each category. A pesticide that falls into category I only because of eye or skin corrosiveness must bear

---

1. This is document No. AE244, one of a series of the Agricultural and Biological Engineering Department, Florida Cooperative Extension Service, Institute of Food and Agricultural Sciences, University of Florida. Publication date: September 2005. Revised September 2008. Please visit the EDIS Web site at <http://edis.ifas.ufl.edu> for additional publications related to citrus best management practices. This document can be accessed as <http://edis.ifas.ufl.edu/AE244>.

2. Brian Boman, Associate Professor, Darren Cole, Engineering Technician, Steve Futch, Multi-County Citrus Agent, Lake Alfred, Ward Gunter, Engineering Supervisor, P. C. Wilson, Assistant Professor, University of Florida, Indian River Research and Education Center, Ft. Pierce, and J. W. Hebb, Multi-County Citrus Agent, Ft. Pierce. Cooperative Extension Service, Institute of Food and Agricultural Sciences, Gainesville, FL 32611.

"Danger" but not "Poison" nor the skull and crossbones symbol on its label.

The LD50 (Lethal Dose) is the amount of a substance at which one-half of the exposed test animals are killed. It is based on the body weight of the animal and is expressed in milligrams of the substance per kilogram of animal (mg/kg). One mg./kg. is equivalent to 1 ppm. The lower the LD50, the greater the toxicity. Although most LD50 values that are readily available in publications are for the pesticide active ingredient or actual toxicant, the signal word on each pesticide product is determined by the toxicity of that particular formulation. Formulated pesticides are usually, but not necessarily, less toxic than the active ingredient. The toxicity categories given in the following tables are based solely on the accompanying LD50 values which, unless stated otherwise, are for the active ingredient. EPA would not necessarily assign the same category shown in the tables. **Refer to the Table at the end of this Document.**

## What Is Exposure?

Accidental exposure or chronic overexposure to pesticides can create serious health problems. While most pesticides pose minimal risks (as long as label directions are followed), others can be extremely toxic and require special precautions. In general the vast majority of pesticide exposure injuries result in only eye/skin irritations.

Pesticide exposures can lead to symptoms of great concern including:

- **nausea/vomiting**
- **headaches**
- **dizziness**
- **shortness of breath**

Wearing protective clothing and equipment while handling or applying pesticides significantly reduces the risk of pesticide poisoning through contact or respiratory exposure.

Treat all pesticides as toxic. Differing degrees of toxicity are potentially dangerous to all people if

exposure is excessive. For this reason it is important to know how toxic each product is and how you can manage and lower the risk for personal exposure.

A pesticide product label will contain one of three signal words: **Danger, Warning, Caution**. These signal words clearly indicate the degree of toxicity associated with the product. Acute or short term toxicities are the basis for assigning pesticides to a toxicity category and selecting the appropriate signal word for the product label. Pesticides that are classified as "highly toxic," on the basis of either oral, dermal, or inhalation toxicity, must have the signal words **DANGER** and **POISON** (in red letters) and a graphic of a skull and crossbones prominently displayed on the package label. **PELIGRO**, the Spanish word for danger, must also appear on the label of highly toxic chemicals. An exposure of a few drops of a highly toxic material taken orally could be fatal to a 150-pound person.

Some pesticide products are labeled with the signal word **DANGER** without the skull and crossbones symbol. This signal word alerts the user of potentially more severe skin or eye effects from the product (caused by its irritant or corrosive properties).

Pesticide products considered "moderately toxic" must have the signal words **WARNING** and **AVISO** (Spanish) displayed on the label. An exposure of 1 teaspoon to 1 ounce could be fatal to a 150-pound person.

Pesticide products classified as either "slightly toxic" or "relatively nontoxic" are required to have the signal word **CAUTION** on the pesticide label. All pesticides regardless of the signal word should be handled with extreme care.

## Routes of Entry

After the signal words, pesticide labels will also include statements concerning routes of entry and specific actions to be taken against exposure.

Route of entry statements indicate the outcome expected from accidental exposure. Some examples from a pesticide label might read: 1) "Poisonous if

swallowed, inhaled or absorbed through the skin" 2)  
"Rapidly absorbed through the skin and eyes."

Pesticides can enter the human body four ways:

**1. Absorption through the skin (dermal)**

**2. Intake through the mouth (oral)**

**3. Intake and passage into the lungs (inhalation)**

**4. Absorption through the eyes (ocular)**

Dermal exposure results from immediate absorption when a pesticide contacts the skin or eyes. Absorption can continue as long as the pesticide remains in contact with the skin. The rate at which this occurs is different for each part of the body (see figure). Some parts of the body absorb pesticides rapidly and need extra protection. Examples of rapid absorption areas are the head and groin area.

Oral exposure to pesticides can cause severe injury. This type of exposure can result in serious illness, or even death. The most common accidental oral exposures occur when pesticides have been removed from their original containers and placed into an unlabeled bottle, jar or food container.

Children under 10 are victims of at least 1/2 of the accidental pesticide deaths in the United States. To prevent oral exposure, follow these guidelines:

- Always store pesticides in their original labeled containers.
- Never use the mouth to clear a spray hose or nozzle, or to begin siphoning a pesticide.
- Never eat, drink or use tobacco until after leaving the work area and washing thoroughly.

Inhalation exposure is particularly hazardous because pesticide particles such as powders, airborne droplets or vapors can be rapidly absorbed by the lungs into the bloodstream. Pesticides can cause serious damage to nose, throat, and lung tissue if inhaled in sufficient amounts and concentration. Vapors and very small particles pose the most serious risks.

Handling concentrated wettable powders can pose a hazard if inhaled during mixing. The hazard from inhaling pesticide spray droplets is fairly low when dilute sprays are applied with low pressure application equipment. This is because most droplets are too large to remain airborne long enough to be inhaled.

However, when using high pressure, ultra low volume (ULV), or fogging equipment, the potential for respiratory exposure is increased. The droplets produced during these operations are in the mist or fog size range and can be carried on air currents for a considerable distance into the working area of other workers.

## Exposure Quiz

### Multiple Choice Questions

1. \_\_\_\_\_ Pesticide absorption through the eyes is known as what kind of exposure?
  - a) Oral
  - b) Dermal
  - c) Inhalation
  - d) Ocular
2. \_\_\_\_\_ Pesticide absorption through the skin is known as what kind of exposure?
  - a) Oral
  - b) Dermal
  - c) Inhalation
  - d) Ocular
3. \_\_\_\_\_ Pesticide absorption through the mouth is known as what kind of exposure?
  - a) Oral
  - b) Dermal
  - c) Inhalation
  - d) Ocular

4. \_\_\_\_\_ Pesticide absorption through the lungs is known as what kind of exposure?

- a) Oral
- b) Dermal
- c) Inhalation
- d) Ocular

5. Pesticide exposures can result in which of the following symptoms?

- a) Nausea
- b) Vomiting
- c) Dizziness
- d) All of the Above

6. Which area of the body absorbs chemicals most rapidly?

- a) Palm of the hand
- b) Scrotal area
- c) Head
- d) Ear canal

7. What is the best way to prevent pesticides from entering the body?

- a) Not using pesticides
- b) Using Personal Protective Equipment
- c) Understanding the label
- d) b and c

## Personal Protective Equipment

Most of the pesticide spilled on the skin is absorbed in the first few minutes. If any pesticide is spilled in this manner, wash it off immediately. The best method to avoid direct contact with pesticides is to wear personal protective clothing. The pesticide label will direct the need for and use of PPE requirements. It is the user's responsibility to follow the directions on the label. **The label is the law!**

## Gloves

Always wear unlined, elbow-length chemical-resistant gloves when handling all pesticides, except those that are relatively nontoxic. Elbow-length gloves protect the wrists and prevent pesticides from running down the sleeves into the gloves. **Refer to the table at the end of this document for gloves made of various materials and the level of protection they offer.**

## Chemical Aprons

Wear a chemical-resistant apron while repairing or cleaning spray equipment and while mixing or loading chemicals. This should be practiced for all pesticide handling but is mandatory for pesticides of category I and II toxicity. Aprons offer excellent protection and barriers against spills and splashes of liquid formulations. Aprons are also useful when handling dry formulations such as wettable powders.

Aprons can be easily worn over other protective clothing and are comfortable enough for use on hot days. Choose an apron that extends from the neck to the knees. Some aprons have other attachments such as sleeves. Nitrile, butyl, and neoprene aprons offer the best protection. PVC and natural rubber are also available.

## Boots

Always wear unlined chemical-resistant boots that cover the ankles while handling or applying moderately to highly toxic pesticides. The boots need thick soles. Nitrile and butyl boots will give the best protection. Do not use leather boots; they are difficult, if not impossible, to decontaminate. If chemical-resistant boots are too hot or cumbersome to wear, try wearing chemical-resistant overboots. Overboots are worn with washable shoes such as canvas sneakers.

Always remember to put your pant legs outside the boots, otherwise the pesticide can drain into the boot. Wash boots after each pesticide application and dry thoroughly inside and out to remove all pesticide residue. It is wise to keep two pair of boots on hand in case of accidental contamination.

## Dust Masks

Protective masks cover the nose and mouth to filter out dust, mists, powders, and small particles in the air. Dust masks should never be worn in place of a respirator. In citrus operations, all respirators must have **MISH/NIOSH** approval number prefix **RC-21C**.

Different types of respirators are required for different pesticide formulations. The pesticide label will describe what kind of filter, cartridge, or canister type to use.

## Respirators

Respirators protect you from breathing pesticide laden air and inhaling toxic chemicals. The pesticide label will tell you if a respirator is required. However, consider wearing one during any lengthy exposure with a high risk of pesticide inhalation. Always wear a respirator while mixing or loading highly toxic pesticides. Applicators who will be constantly exposed, like those mixing, loading, or applying pesticides, to small amounts of moderately toxic pesticides for a day or several days, should also wear a respirator.

**Before a respirator is worn, a qualified person should fit test each person that will be using this safety device. Fit tests are mandatory and are an important step in ensuring that exposure is prevented.**

The respirator should fit properly on your face. It should be worn tightly enough to form a seal all around your face. Respirators come in different sizes. Each person who will wear a respirator must be fit tested prior to using it. A fit test can be provided by your local agri-chemical distributor. Remember that there is no substitute for a respirator. If the label requires the its use it is against the law to proceed without one.

## Goggles or Face Shields

Wear shielded safety glasses, full-face respirators, snug-fitting, non-fogging goggles, or full-face shield whenever any chemical can possibly

come into contact with the eyes. Safety glasses with brow and side shields are acceptable for low exposure situations. Always wear goggles or full-face respirator while pouring or mixing concentrates or while working with toxic sprays or dusts. In high exposure situations when both face and eye protection are needed, a face shield can be worn over goggles.

Clean face shields and goggles after each use with soap and water. Headbands are often made of materials which readily absorb and hold chemicals. For this reason, have several spares and change them often. The best option is to use a chemical-resistant strap. Always wear the strap under your head covering.

## Hearing Protection

Noise of all levels is found in many workplaces. Research has shown that high levels of noise can damage your hearing. Losing your hearing is a gradual process and is less noticeable than other types of workplace injuries. It is, however, a permanent handicap for those who are affected.

Hearing loss has been a common problem among farmers and farm workers for years. Since most farm equipment cannot be operated in a sound-proof enclosure, workers should use hearing protection when operating or working in the vicinity of noisy machinery (see figure). Earmuffs and plugs are available to provide hearing protection for most situations. Modern tractor cabs with noise reduction ratings will also provide adequate hearing protection for most situations.

## Body Covering

Regular work attire such as long pants and a long-sleeved shirt, shoes, and socks are acceptable for slightly toxic (category III) and relatively non-toxic (category IV) pesticides. However, many applicators prefer work uniforms and cotton coveralls that fit the regular-work-attire description and provide equal protection. Applicators should reserve one set of clothing for pesticide use only. Always launder and store the pesticide set separately from all other clothing.

## Resistance Rating

Personal protective equipment (PPE) is given a rating scale by the EPA according to a resistance factor against pesticides.

### HIGH

A high PPE rating means that the material is highly resistant to pesticides in that category. PPE made of this type of material can be expected to protect you for an 8-hour work period. The remaining pieces of the PPE, especially gloves, should be washed at rest breaks or every four hours. Highly resistant PPE is a good choice when handling pesticides, especially concentrates, for long periods of time.

### MODERATE

A moderate rating means that the material is moderately resistant to pesticides in that category. PPE made of this type of material can be expected to protect you for one to two hours. Replace this type of PPE after the allotted time with new items or thoroughly wash the outside with soap and water. PPE with a moderate rating may be a good choice for pesticide handling tasks that last only a couple of hours.

### LOW

A low resistance rating means the material is only slightly resistant to pesticides in that category. PPE constructed with this type of material can be expected to protect you for only a few minutes after exposure to the pesticide product. Replace this type of PPE after the allotted time with new items or thoroughly wash the outside with soap and water. Slightly resistant PPE may be a good choice for pesticide handling tasks that last only a few minutes.

## Cleaning and Disposal

Any respirator that has been contaminated with organophosphate pesticides needs to be washed with

alkaline soap and rinsed with 50% alcohol (ethanol or isopropanol) before normal cleaning procedures.

1. Remove any filters or cartridges from the respirator.
2. Wash the facepiece in cleaner/disinfectant solution.
3. Add suitable cleaner/sanitizer to a gallon of warm water (about 120 F).

Immerse soiled equipment in the solution and gently scrub with a soft brush until clean. Care should be taken to clean the exhalation valve in the facepiece and all other parts that the exhaled air contacts.

1. Rinse completely in clean, warm water.
2. Air dry in a clean area (preferably overnight).
3. Place in a plastic bag for storage and label as to date cleaned.

## Repairs

Any replacement of parts or repairs to the respirator shall be done only with parts designed for that respirator by the manufacturer. There should not be any attempts made to replace components or to make adjustments or repairs beyond the manufacturer's recommendations.

## Storage

After inspection, cleaning, and necessary repairs, respirators should be stored to protect against dust, sunlight, heat, extreme cold, excessive moisture or damaging chemicals. Pesticide approved respirators as well as other PPE should always be stored in a clean, pesticide-free area.

Regular cleaning and inspection prolongs the useful life of all PPE, and assures the wearer that the PPE will perform as efficiently as possible. For personal hygiene and communicable disease considerations, do not pass respirators from one individual to another without cleaning and sanitizing.

Plastic containers with lids provide adequate storage for respirators. During a respirator inspection, check for cleanliness and ensure the components are present and operable.

## PPE Quiz

### True or False

1. \_\_\_\_\_ To determine the toxicity of the pesticide, it is important to read the pesticide label.

2. \_\_\_\_\_ Pesticide-soiled clothing should be removed outdoors.

3. \_\_\_\_\_ All pesticide-soiled clothing can be safely laundered.

4. \_\_\_\_\_ Never pre-rinse pesticide soiled clothing.

5. \_\_\_\_\_ Which glove material below would be the best choice to protect against chemicals?

- a) Leather
- b) Cotton
- c) Butyl-rubber

6. \_\_\_\_\_ When are chemically resistant aprons most useful?

- a) During an application
- b) Equipment clean up
- c) During mixing and loading

7. \_\_\_\_\_ If a respirator is not available which piece of PPE can be used as a substitution?

- a) Dust mask
- b) Goggles
- c) A & B
- d) Neither

8. \_\_\_\_\_ How frequently must respirator cartridges must be replaced?

- a) At least every 8 hours of use
- b) At least every 12 hours of use
- c) At least every 48 hours of use

9. \_\_\_\_\_ What is the best material for work boots while applying pesticides?

- a) Leather
- b) Canvas
- c) Rubber
- d) none of these

## References

United States Department of Labor., Personal Protective Equipment (PPE), <http://www.osha.gov>

Centers for Disease Control and Prevention., Personal Protective Equipment Program, <http://www.cdc.gov/od/ohs/manual/pprotect.htm>

National Agriculture Safety Database., Personal Protective Equipment, <http://www.cdc.gov/nasd/menu/topic/ppe.html>

Personal Protective Equipment and Clothing., Pesticide Information Program, Clemson University, <http://entwed.clemson.edu/pesticid/index.htm>

Protective Clothing for Pesticide Users., Bulletin750, [http://ohioline.osu.edu/b750/b750\\_2.html](http://ohioline.osu.edu/b750/b750_2.html)

## Additional Reading

The following publications that provide information for citrus grove workers are available through EDIS, the UF/IFAS on-line document system.

English

- (Forthcoming)First Aid, Heat Stress, and Safety for Citrus Grove Workers, <http://edis.ifas.ufl.edu/AE242>
- Understanding the Pesticide Label for Citrus Grove Workers, <http://edis.ifas.ufl.edu/AE243>



- Personal Protection Equipment for Citrus Grove Workers, <http://edis.ifas.ufl.edu/AE244>
  - (Forthcoming) Equipment Safety for Citrus Grove Workers, <http://edis.ifas.ufl.edu/AE245>
  - (Forthcoming) Herbicide Application BMPs for Citrus Grove Workers, <http://edis.ifas.ufl.edu/AE246>
  - (Forthcoming) Pesticide Application BMPs for Citrus Grove Workers, <http://edis.ifas.ufl.edu/AE247>
  - (Forthcoming) Fertilizer Application BMPs for Citrus Grove Workers, <http://edis.ifas.ufl.edu/AE248>
  - (Forthcoming) Aquatic Vegetation Management BMPs for Citrus Grove Workers, <http://edis.ifas.ufl.edu/AE249>
  - (Forthcoming) Drainage BMPs for Citrus Grove Workers, <http://edis.ifas.ufl.edu/AE250>
  - (Forthcoming) Irrigation Management BMPs for Citrus Grove Workers, <http://edis.ifas.ufl.edu/AE251>
  - (Forthcoming) Riser Board Water Control Structure BMPs for Citrus Grove Workers, <http://edis.ifas.ufl.edu/AE252>
  - (Forthcoming) BMPs for Citrus Grove Maintenance Facilities, <http://edis.ifas.ufl.edu/AE253>
- Spanish**
- (Forthcoming) Primeros Auxilios, Insolación y Seguridad para los Trabajadores de Cítrico, <http://edis.ifas.ufl.edu/AE270>
  - (Forthcoming) Entendiendo la Etiqueta del Pesticida para los Trabajadores de Cítrico, <http://edis.ifas.ufl.edu/AE271>
  - (Forthcoming) Equipo de Protección Personal para los trabajadores de Cítrico, <http://edis.ifas.ufl.edu/AE272>
  - (Forthcoming) Seguridad con el Equipo para los Trabajadores de Cítrico, <http://edis.ifas.ufl.edu/AE273>
  - (Forthcoming) Mejores Prácticas de Manejo en Aplicaciones de Herbicida para los Trabajadores de Cítrico, <http://edis.ifas.ufl.edu/AE274>
  - (Forthcoming) Mejores Prácticas de Manejo en Aplicaciones de Pesticida para los Trabajadores de Cítrico, <http://edis.ifas.ufl.edu/AE281>
  - (Forthcoming) Mejores Prácticas de Manejo en Aplicaciones de Fertilizante para los Trabajadores de Cítrico, <http://edis.ifas.ufl.edu/AE275>
  - (Forthcoming) Mejores Prácticas de Manejo en Aplicaciones de Malezas Acuáticas para los Trabajadores de Cítrico, <http://edis.ifas.ufl.edu/AE276>
  - (Forthcoming) Mejores Prácticas de Manejo con Drenaje para los Trabajadores de Cítrico, <http://edis.ifas.ufl.edu/AE277>
  - (Forthcoming) Mejores Prácticas de Manejo con Irrigación para los Trabajadores de Cítrico, <http://edis.ifas.ufl.edu/AE278>
  - (Forthcoming) Mejores Prácticas de Manejo con compuertas de retención de agua para los Trabajadores de Cítrico, <http://edis.ifas.ufl.edu/AE279>

- (Forthcoming) Mejores Prácticas de Manejo para el Mantenimiento en Facilidades Agrícolas, <http://edis.ifas.ufl.edu/AE280>

**Glove Material and Use Chart.** Use this table to guide the proper selection of gloves with different material composition and physical and chemical protection.

<u>Glove Material</u>	<u>Use</u>
Butyl-rubber gloves	Highly resistant to gas, water vapors, common acids and alcohols
Hot-mill or Aluminized gloves	Protect against heat and welding sparks
Latex gloves	Chemical-resistant and liquid proof
Natural rubber	Liquid proof, acids, and caustics
Nitrile/Natural rubber	Chemical resistant for most acids, alkalis, and grease
Nitrile/Rubber blends	Resists abrasions, cuts, tears and punctures some chemical resistance
Neoprene gloves	Acids, caustics, oils, grease and many solvents
Neoprene latex	Detergents, salts, acids and caustic solutions
PVC-coated gloves	Chemicals, oils, and grease
Silver shield gloves	Wide range of solvents, acids, and bases protection
Vinyl gloves	Irritant protection
Viton gloves	Solvents, gas and water vapors resistance
Cotton or Canvas gloves	Parts handling, general maintenance, and abrasion resistance.
Leather gloves	Mild heat resistance, and good abrasion resistance

**Pesticide Categories.** This table shows the signal words that must appear on the pesticide label for each toxicity category and the range of the oral and dermal median lethal doses (LD50) for each category.

TOXICITY CATEGORY	SIGNAL WORDS REQUIRED ON LABEL BY EPA	ORAL LD50 (MG./KG.)	DERMAL LD50 (M.G./K.G.) 24-HR. EXPOSURE	ORAL DOSAGE TO KILL AN ADULT*
I. Highly Toxic	DANGER, POISON, Plus Skull & Crossbones symbol	0 to 50	0 to 200	A few drops to 1 tsp.
II. Moderately Toxic	WARNING	50 to 500	200 to 2,000	1 tsp. to 2 Tbsp.
III. Slightly Toxic	CAUTION	500 to 5,000	2,000 to 20,000	1 oz. to 1 pt. (1 lb.)
IV. Low Toxicity	CAUTION	>5,000	>20,000	1 pt. (1 lb.) or more

**PPE Quiz Answers.**

Question Number	Correct Answer
1	True
2	True
3	True
4	False
5	c
6	c
7	d
8	a
9	c

**Exposure and PPE Quiz Answers.**

Question Number	Correct Answer
1	d
2	b
3	a
4	c
5	d
6	b
7	b