

Chapter 9.
Applicator Safety in Herbicide Applications for
Rights-of-Way Vegetation Management

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Important Terms

acute	LD ₅₀	Caution
chronic	MSDS	Warning
dermal	MTD	Danger
hazard	NOEL	toxicity
inhalation	oral	
LC ₅₀	signal words	

Some classes of pesticides are hazardous to human health because the life process they control in pests works the same way in humans. For example, rodenticides and insecticides that interfere with the enzyme cholinesterase in pests can interfere with the same enzyme in people causing uncontrolled twitching and loss of nerve control. In contrast, most herbicides are designed to disrupt processes in plants that are not present in humans, such as interfering with root or shoot growth. Most herbicides are not readily absorbed through the skin. Most are rapidly broken down and excreted in urine and feces. Properly trained applicators should always take precautions and follow label instructions to minimize exposure since, for most products, the level of toxicity determines the amount of safety equipment that must be worn.

TOXICOLOGY TERMS

Exposure to herbicides occurs in two primary ways: acute and chronic exposure.

Acute

Acute exposure is a single dose of a large amount of herbicide through ingestion, or eye, lung, or skin contact such as could occur during mixing. It can also include spilling or spraying the product onto clothing or onto the face or body as a result of broken or leaking equipment. Symptoms of acute poisoning usually begin within minutes or hours after exposure and are easily traced to a specific exposure. Acute exposure can also include irritation and burns.

Acute **oral exposure** refers to a single dose taken by mouth (ingestion). Acute **dermal exposure** refers to a single dose directly contacting the skin (skin absorption). Acute **inhalation exposure** refers to a single dose exposure through breathing or inhaling in an enclosed area. Few herbicides are highly toxic to humans, and few herbicides are readily

absorbed through the skin. Since most rights-of-way herbicide mixing usually occurs outdoors, inhalation is generally not a problem. However, always take precautions to avoid breathing herbicide vapors, mists, or dusts.

Chronic

Chronic exposure is the result of repeated contact to low levels of a pesticide over a long period of time. Chronic effects may appear after months or even years. Chronic exposure is often the result of inadequate or improper use of protective clothing or equipment. It can occur from wearing the same contaminated clothes without proper laundering or by not washing or bathing after working with a herbicide product.

The results of chronic exposure response might include allergies, cancer, birth defects, and organ damage. However, several toxicology tests are required before a herbicide can be registered. These include effects on reproduction (teratogenic), ability to cause cancer (carcinogenic), ability to cause genetic mutation (mutagenic), and organ toxicity. A properly trained applicator should understand the long-term hazards (if any) associated with the products they work with.

Toxicity and Hazard

The terms toxicity and hazard do not mean the same thing. **Toxicity** is a measure of the ability of a chemical to cause harm; injury, illness, or death. **Hazard** is the possibility that injury can occur and includes two factors -- toxicity of the product or mixture and the amount of exposure. A herbicide diluted in water has the same toxicity as the concentrated form, but presents less of a hazard because the applicator must be exposed to a greater quantity of solution to receive the same amount of herbicide or toxicant. Applicators should be particularly knowledgeable of the hazards of handling concentrated forms of herbicides before they are mixed for application.

LD₅₀ and LC₅₀

The terms **LD₅₀** and **LC₅₀** are used to express the level of acute toxicity of herbicides. LD is an abbreviation for "lethal dose." The LD₅₀ is a single dose of a chemical that, when fed to a group of test animals or applied dermally, will kill 50% of the animals. LC means "lethal concentration." LC₅₀ is the concentration of the chemical in the air or water that will kill 50% of the test animals with a single exposure. In most cases, herbicide acute toxicity measurements are determined on both male and female rats. LD amounts are expressed in milligrams of

product per kilogram of body weight (mg/kg). LC amounts are expressed in terms of milligrams of chemical mist, or dust, per liter of air (mg/l) or as milligrams of herbicide per liter volume of solution (mg/l), usually water. Milligrams per liter is equivalent to parts per million (ppm). The higher the LD₅₀ or LC₅₀ value the less toxic the herbicide. This may seem, at first glance, to be incorrect. The higher the LD₅₀ means it takes more of the herbicide to kill half of the test animals; therefore, the product is considered less toxic than those herbicides which kill half the animals at lower doses. A herbicide with an acute oral LD₅₀ of 5,000 mg/kg requires almost 0.1 ounce of the herbicide per pound of body weight to reach the LD₅₀ value. LD₅₀ and LC₅₀ values can be measured for both the active herbicidal compound or for the entire herbicide formulation, which can include the inert ingredients and adjuvants.

The LD₅₀ and LC₅₀ values are normally found on the Material Safety Data Sheets (**MSDS**) for each product. Pesticide labels will generally not provide the LD₅₀ or LC₅₀ values. Instead these numbers are provided to the applicator through a signal word found on each pesticide label. The signal words are **CAUTION** (high LD₅₀ or LC₅₀ values), **WARNING** (moderate LD₅₀ or LC₅₀ values), and **DANGER** (low LD₅₀ or LC₅₀ values). Generally speaking, DANGER/POISON labeled products require greater protective equipment than those products classified as WARNING or CAUTION. Likewise, a product with the signal word WARNING may require additional safety equipment than those herbicides with a CAUTION signal word. It is important to note that the signal words provide a quick overview of the product's acute toxicity to the person handling the product.

No Observable Effect Level

No Observable Effect Level (**NOEL**) is the highest exposure dose that gave no effect on the animals in a particular toxicological test. It is an important measure because LD₅₀ and LC₅₀ values do not indicate the toxicity of a compound over a range of herbicide concentrations. For example, two compounds may have the same LD₅₀ value, but one is much more toxic at a lower dosage than the other. Not only are NOEL values useful in acute and chronic toxicology studies, but also are critical in determining maximum tolerated doses (**MTD**) based on results of reproductive, teratogenic, mutagenic and carcinogenic studies. From the NOEL, a safety factor of 100 to 1,000 times greater dose is often built into MTDs to account for different sensitivity levels that are possible between experimental test animals and other animals or humans.

ROUTES OF EXPOSURE

Most herbicides have low toxicity (high LD₅₀). Exposure levels that can cause illness are rare. However, herbicides with low toxicity can irritate the nose, throat, eyes, and skin of sensitive applicators. Know how to protect yourself, your workers, and other people from the possible effects due to exposure of the herbicides being mixed or applied.

The manner by which the herbicide contacts the body plays a critical role in how the body responds to the herbicide. Herbicides can enter the body through the mouth (**oral**), through the skin and eyes (**dermal**), and through the lungs (**inhalation**).

Oral exposure can occur by not washing your hands before eating, drinking, smoking, chewing, or by wiping your hand across your mouth.

Dermal exposure can occur by not washing your hands after handling herbicides or their containers, not wearing gloves while mixing and loading and handling containers, directly splashing the product on the skin, the spray mist contacting unprotected skin or eyes, wearing herbicide contaminated clothing (including hats, boots and gloves), wearing inadequate or improperly cleaned protective clothing and safety equipment, handling contaminated equipment during mixing or application, and not washing gloves and boots before removing them.

Inhalation exposure can occur by breathing vapor, dust or mist during mixing or application, and by not wearing appropriate protective equipment.

PERSONAL PROTECTIVE EQUIPMENT

The most important thing that an applicator can do to reduce exposure is to wear the personal protective equipment (PPE) required by the herbicide label. Follow all directions on the label regarding protective clothing. The mentioning of only one piece of safety equipment does not rule out the use of additional protection. Understanding herbicide toxicity, route of entry, length of exposure, and mixing and application methods should help you assess the hazard and select the proper protective clothing. You must know and comply with all label requirements. The greatest potential for exposure occurs while handling concentrated products during mixing and loading. Your hands and forearms offer the greatest potential for herbicide exposure. The product label or state regulations may specify additional protective clothing to be worn during loading that may not be required during application. Remember, the PPE required by the label

is based on the LD₅₀ or LC₅₀ values, concerns about chronic exposure, and possible irritation of skin or eyes.

Hand Protection - Gloves

- ✎ Wear appropriate gloves when handling herbicide concentrates or when in contact with the spray solution, such as cleaning nozzles or adjusting the sprayer.
- ✎ Gloves should be long enough to protect the wrist.
- ✎ Liquid-proof, unlined, chemical-resistant (neoprene or nitrile) gloves are best for liquid formulations.
- ✎ Gloves should **NOT** be fabric-lined because the lining absorbs herbicides.
- ✎ Most labels require wearing long-sleeved shirts. Shirtsleeves should be outside of the gloves to keep the herbicide solution from running down the sleeves and into the gloves. However, when spraying or working with your hands and arms over your head, the shirtsleeves should be inside the gloves to prevent the herbicide from running from the gloves on to unprotected skin of the hands and arms.
- ✎ Gloves should be washed with soap and water before you remove them to prevent being exposed to herbicides when you remove, store, or re-use them.
- ✎ Test your gloves for leaks by filling them with water and gently squeezing.
- ✎ Replace gloves when the exterior shows signs of tearing, staining, or distress.

Eye Protection – Goggles and Face Shield

Since eyes can readily absorb most herbicides, wear some form of eye protection, such as safety glasses with brow and side protection, goggles, or a face shield. Liquid products can splash and dry materials can bounce or be blown into unprotected eyes.

- Be aware that goggles can fog up and present a different type of hazard.
- It's best to purchase safety glasses with UVL protection. This will help protect the eyes from the herbicide and blocks the sun's rays.
- Wash your eye protection equipment after each use so you do not become exposed to herbicide with the next use.
- When not in use, store safety glasses or goggles in a container to help protect them against scratches and breaks.

Head Protection – Hat

- o Wear some form of head covering to protect your head anytime you are handling or applying herbicides.
- o A wide-brimmed hat will help keep herbicides off your neck and face.
- o Hats should not have a cloth or leather sweatband as they absorb chemicals and are difficult to clean.
- o A separate sweatband should be easy to clean or be disposable.
- o Baseball-type caps provide limited head protection from chemical exposure, and should be washed regularly with other clothes you wear during application.

Foot Protection - Shoes and Boots

- o Sturdy shoes or boots are sufficient for most herbicide applications. Canvas or cloth boots can absorb herbicide and should be avoided.
- o Boots are worn with trouser legs outside the boots to prevent the herbicide from running down your legs and into the boots.
- o Neoprene or rubber boots are good precautionary gear when applying liquid herbicides in areas that must be walked through while making the application or when required by the product label.
- o Rinse your neoprene boots before removing them to prevent exposure to chemicals when handling them.

Lung Protection - Respirators

The respiratory tract, including the lungs and other parts of the breathing system, is the fastest route for herbicide exposure. You must wear an approved respirator if required on the label.

Very few herbicides require the use of a respirator, but follow label directions for those that do.

Surgical and Dust Mask

Dust masks can trap dust particles and pollen, but should **NOT** be considered to be respirators for handling pesticides.

Cartridge Respirator

A functional cartridge respirator absorbs herbicide vapors when the inhaled air is drawn through both a fiber filter pad and a cartridge. Cartridge respirators cover only the mouth and nose. For this reason, it is best to use one that is combined with goggles, or wear separate goggles that protect your eyes. Newer cartridge respirators are lightweight and disposable. Respirators are

usually not required when using herbicides. Whether you are legally required to wear a NIOSH (National Institute of Safety and Health) approved respirator will depend on the herbicide label. If you do wear a respirator, wash it daily and check for proper fit before each use to prevent exposure to chemicals when wearing it again.

While it is beyond the scope of this manual, applicators should never wear a respirator unless they have completed an OSHA (Occupational Safety and Health Act) approved medical questionnaire, been examined by a physician if required, and been fitted by a trained professional to ensure the proper respirator is selected. It is almost impossible to successfully fit a respirator to your face if you wear a beard.

Hearing Protection

Ninety decibels is the maximum continuous volume limit for an 8-hour period allowed by OSHA. Control noise at the source by keeping the engine exhaust system in good repair and by using good quality mufflers on every machine.

The two basic types of hearing protection are the insert and the muff. The insert is placed in the ear canal and is made of rubber, plastic, wax, or special cotton-like fibers such as "Swedish wool." The muff, or cup type, resembles earphones and covers the external ear to provide an acoustical barrier.

Rubber and plastic inserts must be properly fitted to assure a good seal and should be reasonably comfortable. They tend to work loose with jaw movement. They must be kept clean. Wax and "Swedish wool" inserts are shaped by hand and are useful where loud noise is only occasional. They are inexpensive and can be discarded after one use.

Muff protectors can quickly be taken off and put on as needed. They are ideal where loud (more than 90 decibels) noise is continuous or for short durations. They provide more dependable protection than inserts.

If you experience headaches and/or temporary loss of hearing while working in a noisy area, then hearing protection is a must.

Whole Body Protection – Coveralls and Safety Vests

If you are wearing only a shirt and trousers, you should consider wearing coveralls or a liquid-proof apron when handling concentrates. If you wear a cover-all type garment, it should be

made of woven or laminated fabric that has been manufactured for this purpose. Fabric garments should be laundered regularly. Disposable protective clothing can also be used for herbicide applications. Disposable fabrics are usually lightweight and strong and have the advantage of not requiring cleaning or decontamination after use.

Bright reflective vests are required on many operations where applicator visibility is critical, such as roadsides and railroads.

FIRST AID BASICS

While herbicide poisonings are rare for rights-of-way applicators, it is still important to recognize signs and symptoms of herbicide poisoning. When in doubt, seek medical attention and be sure to bring the herbicide label and MSDS to the physician.

Herbicide Poisoning Recognition

Certain herbicides may cause an allergic reaction in a sensitive person. It is important to know the signs and symptoms most likely to be caused by the herbicides you use. Symptoms such as nausea or headache are noticeable only to the affected person. Other people can see signs, such as vomiting, sweating, sluggishness, staggering, swelling, or rash development. Know what your own symptoms might mean and what signs of poisoning to look for in your coworkers.

Herbicides that are chemically similar to one another often cause the same type of symptoms. They may be mild or severe, depending on the specific herbicide involved and the level of exposure. If you have been working with herbicides and some signs or symptoms begin to develop, let your co-workers know, and get medical attention quickly. The herbicide label or MSDS will have a telephone number to contact in case of a medical incident.

Procedures

Get medical attention quickly if you or any of your fellow workers experience unusual or unexplained symptoms that start during work hours or later the same day.

Do not allow yourself or anyone else to become extremely sick before calling a physician or going to a hospital.

Read the first aid instructions on the product label or the Material Safety Data Sheet (MSDS) for each product.

Follow the instructions, and avoid becoming exposed while trying to help another person.

Give the label and MSDS to the physician or emergency personnel. Most labels have a telephone number to contact in case of medical emergencies involving the product. You should provide this number to medical personnel.

Most of the following recommendations are useful for most types of pesticide exposure. Always read the label for more specific instructions.

Herbicide on Skin

Wash the herbicide from skin with soap and water. This should be adequate in most instances of skin exposure. You should have a ready supply of soap and clean water on the spray equipment to wash your hands or protective equipment after working on the sprayer or coming in contact with the spray solution. Seek medical treatment if there are skin burns or an irritation persists.

Herbicide in Eye

Eye exposure to herbicides can be serious. Always pour, measure, or mix herbicides with the containers held below eye level to avoid splashing the product into your eyes. Wettable powders and granules are abrasive and may damage your eyes. Always wear eye protection when mixing.

If herbicides contact your eye(s),

- Remove any protective equipment and wash the eyes quickly but gently.
- Hold the eyelid open and wash with a gentle stream of clean running water.
- Wash for 15 minutes or more.
- Do not use chemicals or eye wash solutions in the wash water because they may increase the extent of the injury.
- Seek medical attention if irritation or burning in the eyes persists.

Herbicide in the Lungs

Because herbicides are used outdoors, inhalation is not a common route of exposure.

However, there are situations with potential inhalation exposure, such as while mixing wettable powders and handling herbicides in a storage room or rail car.

- o Stand where the wind blows across your body so the wind will carry any herbicide dust away from you.
- o Cutting the bags, rather than tearing them, avoids stirring up any dust from the product.

Herbicide in Mouth or Swallowed

Rinse the mouth with plenty of water. If herbicide is swallowed read and carefully follow all instructions on the product label regarding treatment. Induce vomiting **only** if instructed to do so on the label. Get medical attention.

Supplies

A standard first aid kit is important for treating cuts and scrapes associated with working around equipment.

A supply of clean water for emergency eye flushing should be readily available at the storage facility, on the application equipment, and at the job site. This water should **NOT** be contaminated in any way. Special eye washing kits that contain water and eye cups can be purchased from safety supply stores.

Soap and water for routine hand washing should be kept with each piece of equipment, especially if crews eat on location. When using waterless hand cleaners for routine cleanup, you should rinse the cleaner off with water when available.

Also consider a Tyvek suit that can be worn in the event of an applicator's clothing becoming contaminated.

"Spill kits" are available commercially and include absorbent materials that will help contain a minor jobsite spill until you can properly dispose of the material.

SUMMARY

There are hazards associated with weed control whether by applying herbicides or using mechanical equipment such as weed-eaters, mowers, and saws. There is no need to take short cuts when it comes to the safe handling of pesticides. Wearing the required personal protection equipment will reduce most hazards associated with the use of herbicides. A well-trained applicator will avoid unnecessary exposure and follow the directions on the label. The label is always the best source of information.

If nozzles clog or other trouble occurs in the field, be careful not to contaminate yourself while correcting the problem. Shut off the sprayer and move it out of the treated area before making repairs or corrections. Wear protective clothing while making repairs. You should clean plugged nozzles with a soft bristle brush, wooden pick, or something similar. Never use your mouth, wire, or pocketknife.

Chapter 9 Example Test Questions

1. The ability of a herbicide to cause injury or death is called:
 - A. Acute
 - B. Chronic
 - C. Risk
 - D. Toxicity

2. Hazard is reduced by:
 - A. All of the following
 - B. Using the product in a diluted form
 - C. Using a formulation that is not readily absorbed through the skin
 - D. Wearing appropriate protective clothing

3. A single exposure to a large amount of herbicide is _____ exposure?
 - A. A chronic
 - B. An acute
 - C. An LD50
 - D. A synergistic

4. Repeated exposure to low levels of herbicides over a long period of time is _____ exposure?
 - A. A chronic
 - B. An acute
 - C. An LD50
 - D. A synergistic

5. Chronic exposure can result from:
 - A. Inadequate protective clothing
 - B. Wearing contaminated clothing
 - C. Not bathing
 - D. All of the above

6. Oral exposure means the herbicide is:
 - A. On the skin
 - B. Inhaled
 - C. Swallowed
 - D. In the eyes

7. The greatest risk of herbicide exposure occurs:
 - A. While reading the label on the container
 - B. During mixing and loading
 - C. During application
 - D. All are equal

8. Gloves worn when applying herbicides should be:
- A. Unlined
 - B. Liquid proof
 - C. Worn inside the shirt sleeve
 - D. All of the above
9. Which of the following statements is correct?
- A. All of the following.
 - B. Keep containers below eye level when pouring to avoid splashing into your eyes.
 - C. Wettable powders are abrasive and may damage your eyes.
 - D. Wear eye protection when mixing.
10. Induce vomiting:
- A. If an emulsifiable concentrate has been swallowed
 - B. If the victim is having convulsions
 - C. If the label instructs you to do so
 - D. If milk is not available to drink

Answers:

- | | | | | | | | | | |
|----|---|----|---|----|---|----|---|-----|---|
| 1. | D | 3. | B | 5. | D | 7. | B | 9. | A |
| 2. | A | 4. | A | 6. | C | 8. | D | 10. | C |