

Forest Herbicide Safety: Environmental Concerns and Proper Handling



The increasing use of herbicides in forests and other agricultural areas has caused concerns about the damage these compounds can do to humans and the environment. Suggestions are presented on environmental safety and proper procedures for handling, storing, transporting, and applying herbicides. Although there are references to specific herbicides used in forest management, this information is applicable to any herbicide.

Environmental Safety

Damage to the environment can occur due to accidents and misapplication because:

- A. Mists from sprays and volatilized herbicides on hot days can drift for miles in high winds and may damage nearby crops.
- B. Runoff from treated areas may kill algae, aquatic organisms, and fish.
- C. Careless flushing of equipment can contaminate soil, wells, and surface water, killing desirable plants and trees.
- D. Off-site applications can occur if boundaries are not clearly marked and known by the applicator.

Because of potential environmental damage when using herbicides, the applicator must understand potential hazards and ways of avoiding problems. Drift depends on the wind conditions. Drift can cause problems off-site, and influence the rate of application on-site. For instance, if a gust of wind moves your swath 20 feet during a pass, you have an area that was skipped and an area that received a greater rate than required. You can avoid drift problems by knowing your product, your application equipment, and the degree that wind speed affects

the herbicide's distribution. For instance, a granular formulation is less affected than a liquid spray. For your equipment, and the product you are using, develop wind speed guidelines that cause you to shut down. For liquid applications, that could be 5 mph. After setting that policy, follow it. If you held a job for 3 days because of the weather, the conditions you will accept for resuming work should be the same as the first day on the job.

Off-site movement due to volatilization can also be a problem. Liquid herbicides that are ester formulations are much more likely to volatilize than are amine formulations. If you expect temperatures to exceed 90-95 degrees and sensitive crops are planted in the vicinity, you do not apply products that may volatilize.

Since wind and temperature could cause problems, on-site monitoring and recording of weather conditions during application are necessary. By doing this, you will know when conditions require you to shut down, and the records will assist you if an adjacent landowner files a claim. You must know the location of crops, homesites, streams, ponds, and other sensitive areas within and adjacent to the treatment area. A pretreatment reconnaissance and sketch map are needed. Establish buffer strips around sensitive areas to protect from drift and runoff. You are liable for damages resulting from the application; thus, it is critical that the environmental concerns are a major concern of the applicator.

Terms and Definitions

Acute toxicity: A measure of the ability of a chemical to cause injury or death from one exposure.

Chronic toxicity: The ability of a substance to cause injury or death after long-term exposure.

Dermal Toxicity: The ability of a substance to cause injury or death if passed through unbroken skin.

Exposure: Coming into contact with a chemical by swallowing, breathing, or through contact with the skin.

Hazard: The degree of exposure combined with the level of toxicity.

Herbicides: Chemicals that control plant pests.

LD₅₀: The amount (or lethal dosage) of a chemical required to kill 50 percent of the test animals.

Oral Toxicity: The ability of a substance to cause injury or death if swallowed.

Pesticides: Chemicals that control, prevent, destroy, or regulate pests.

PPM (Parts Per Million): a way to express the amount of pesticide in water, plants, food, or animals. 1 ppm is equal to about 1 ounce in 62,500 pounds or 1 tablespoon in 3,906 gallons.

Toxicity: The measure of the ability of a chemical to cause injury or death.

Measuring Toxicity

Toxicity, the capacity of a substance to cause injury, varies depending on the chemical. Some chemicals are extremely toxic while others are essentially nontoxic. However, large enough quantities of almost any substance can cause a toxic response.

To understand the toxicity of herbicides, it helps to know how toxicity tests are conducted. Test animals (such as mice, rats, and rabbits) are fed measured doses of a chemical. By increasing the amounts of chemical fed to test animals, the amount required to kill one-half (50 percent) of the animals can be determined (LD_{50}). This dosage is usually referred to in terms of the weight of the chemical and the weight of the test animal. For example, the herbicide Accord has an LD_{50} rating of 5,400 mg/kg. Approximately 1 pint of Accord in the concentrated form would have to be ingested for a 175-pound person to reach the LD_{50} dose.

Table 1 gives toxicity categories for pesticides, and Table 2 provides LD_{50} ratings for common herbicides. Other common substances frequently handled are listed for comparison. Also, Table 3 estimates the LD_{50} for a 175-pound person for a range of substances. From this information, several points can be made. As the LD_{50} rating becomes larger, the substance becomes lower in toxicity. For example, Product A with an LD_{50} rating of 40 mg/kg is much more toxic than Product B which has a LD_{50} rating of 4,000 mg/kg. Also, many herbicides have an acute toxicity rating less toxic than many frequently used household compounds.

Many people wonder how a herbicide that is extremely effective at killing unwanted plants can have such little toxicity for humans. Plants differ from humans in many ways. Researchers rely on those differences to produce chemicals that interrupt a plant's function, but have little effect on humans. For example, in a process called photosynthesis, plants produce their own food by using carbon dioxide from air, water from the soil, and sunlight. Since we do not have this ability, a chemical that blocks this process has a lethal effect on a plant yet does not affect humans. Other plant processes, such as blocking the

synthesis of a particular amino acid that only plants can make, can be altered in a similar way. This too results in the death of the plant, but has no influence on people.

Although the acute LD_{50} rating may indicate that the compound is relatively low in toxicity, take precautions when mixing, handling, or applying herbicides.

Mixing, Handling, and Applying Herbicides

The first step in using herbicides safely is to read and understand the label before you mix or apply. The label contains precautionary statements and warnings as well as a list of protective clothing and equipment required when using it. As mentioned earlier, herbicides generally interrupt a plant's function. Because of this, herbicides are usually the least toxic of all pesticides. However, when handling a concentrated herbicide, take precautions.

Avoid unnecessary exposure. In their concentrated form, many herbicides can cause skin irritation and eye damage. Therefore, always use protective eye wear when mixing herbicides and also wear neoprene or rubber gloves. Protective clothing includes long-sleeved shirts, long pants, and water- and chemical-resistant boots.

If you have cuts or abrasions on your skin, be sure they are properly bandaged before you apply the chemical. Always check your equipment for leaks and calibrate with water before application. Always stay upwind from the nozzle so the chemical is blown away from you. Bring out to the field with you wash water and detergent in clearly marked containers.

In case of a spill, wash the herbicide off immediately. Also, take a change of clothes with you to the application site so you can change if your clothes become contaminated. Before eating and or smoking, always wash your hands and face thoroughly. Always wash contaminated clothing separately from non-contaminated items.

Clean and thoroughly rinse your equipment after application. The best

area for cleaning is on a wood rack or a concrete apron with a good sump. A second alternative is to carefully apply the rinse water on the site where the herbicide was applied.

When using herbicides, whether mixing, applying, or rinsing equipment after use, always be certain you are not contaminating someone's water supply. Several precautions can be taken to avoid this problem. Never apply any chemical near a well or other water source. When possible, use a nurse tank to mix only the herbicide needed for that day's work in the field. When filling from a well, use a separate pump with check valves to prevent back siphoning.

Herbicide Disposal, Storage, and Transport

Disposal

After applying a herbicide, excess chemicals and empty containers should be disposed of or stored properly. Preventing pesticide surplus is the best way to minimize disposal problems. Before buying, check to make sure the herbicide is labeled for the usage you intend. Carefully estimate the amount of herbicide needed to complete the job and buy only what is needed. Wait until you have checked the site and are sure that the weather conditions will allow you to apply before you mix the herbicide into the tank. Also, mix only what is needed for that day.

Although steps can be taken to minimize any excess chemicals, empty containers must always be disposed of properly. After application, triple-rinse all empty containers. Pour rinsate back into the spray tank and not directly on the ground. It is also a good idea to punch holes in metal containers so they cannot be used again. Lastly, dispose of all containers in a sanitary landfill.

Storage

The proper storage of herbicides is essential to their safe use. Designate an area where only pesticides are to be stored. This area should be secured with a lock and each entrance prominently posted:

Warning-Pesticides-Keep Out. Ideally, the storage area should be made of fire-resistant materials, including a concrete floor. The storage area should be cool, dry, and have an exhaust fan for proper ventilation.

Never store pesticides near food, feed, seed, or animals. Separate each type of chemical so herbicides, fungicides, and insecticides are stored separately. Also, each type of herbicide should be grouped separately. For example, group all containers of Garlon 4 together; then group containers of Roundup together. Always store containers so labels can be clearly seen. It is also a good practice to store containers off the ground on wooden crates to avoid moisture problems. Keep an up-to-date inventory of all chemicals stored, including the date they were purchased, used, and placed into storage.

The storage area should be kept clean and orderly. Have an absorptive clay, activated charcoal, pet litter, or sawdust readily available at the storage site to help clean up any spills. Also, have a shovel, broom, and dustpan available. In case of fire, always keep a fire extinguisher in the storage area.

Transporting

The following precautions can be helpful in safely transporting herbicides:

- Check to make sure that containers are not damaged before loading or during transport.
- Take only the amount needed for that day with you.
- Do not transport herbicides in the passenger section of the vehicle. Do not transport herbicides in the trunk of passenger cars or in trucks with wooden beds. Use a trailer to transport herbicides when using a car.
- Use rope and straps to secure containers so they will not move during transport. During the trip, periodically check containers to be sure they have not shifted and spilled.

When at the application site, park the truck (or store the containers) in the shade. Direct sunlight can cause the containers to overheat, resulting in a pressure buildup. A tarp can be used to shade the containers as well.

Spill Procedures

If an accident occurs during transport and a minor spill results, administer first aid to anyone who may have been injured. Confine the spill. If it starts to spread, dig a dike around the area to contain it. Always take a shovel with you when hauling herbicides. Use an absorbent or clay-like material, such as the ones mentioned in the storage section earlier, to soak up the herbicide. Dispose of the contaminated absorbent as you would excess herbicide.

If an accident results in a major spill (one that endangers people, property or the environment), administer first aid, then call the manufacturer. The number to call in case of an accident is prominently displayed on every label. The manufacturer will tell you which authorities to notify and what actions need to be taken.

Read the Label

The label is your single most important source of information for safe herbicide use. The herbicide label contains comprehensive information and instructions that give the physical and chemical natures of the product, precautionary statements, and warning important for proper application. Additionally, detailed information is provided on the application, storage, and disposal of the product. The manufacturer's address and phone number are also listed.

Information regarding the brand name, chemical name, type of formulation and EPA registration numbers are also included. This information is necessary for a physician to know in case of an accidental poisoning. The most important time spent in herbicide application is the time you take to read and understand the label.

Always read the label four times:

1. Before buying the herbicide
2. Before preparing the material for use
3. Before applying
4. Before storage or disposal.

Before purchasing a herbicide, read the label to ensure the chemical is properly labeled for your particular job, and that it is suitable for your equipment conditions, and site. Before preparing the chemical for use, read the label for any warning or precautionary statements, and use any protective equipment recommended.

The label tells you the amount of herbicide needed and its compatibility with other chemicals or carriers, such as diesel fuel. In addition, the label gives the waiting period for crops and animals, the rate and methods of application, and any restrictions in the use of the chemical.

Reading the label before storing or disposing of the product helps you determine where and how to store the chemical, as well as the proper methods for disposing of the containers or surplus product.

Summary

Herbicides are effective tools that, when used properly, will accomplish many useful and necessary functions. However, those who use herbicides must educate themselves on the safe and proper ways to use the chemicals. The primary source of such information is the herbicide label. If, after reading the label, you are uncertain about something, stop and get help. There are numerous sources of information including your County Extension Office and the people who manufacture and distribute herbicides. When using herbicides, always remember: Read the label and when in doubt, stop and get assistance.



Table 1. Toxicity categories.

Toxicity Category	Signal word	Oral LD ₅₀ ¹ (mg/kg)	Dermal LD ₅₀ ¹ (mg/kg)	Inhalation LD ₅₀ ¹ (mg/kg)	Eye effects	Skin effects	Estimated amount needed (orally) to kill an average-sized person
I	Danger	<50	<200	<0.2	Corrosive; corneal opacity not reversible within 7 days	Corrosive	A taste (<7 drops) to a teaspoonful
II	Warning	50-500	200-2,000	0.2-2.0	Corneal opacity reversible within 7 days; irritation persisting for 7 days	Severe irritation at 72 hours	A teaspoonful to an ounce
III	Caution	500-5,000	2,000-20,000	2.0-20	No corneal opacity; irritation reversible within 7 days	Moderate irritation at 72 hours	An ounce to a pint
IV	Caution	>5,000	>20,000	>20	No irritation at 72 hours	Mild or slight irritation	Greater than a pint

¹For the labeled product.

< less than

> greater than

Table 2: Oral toxicities of silvicultural herbicides and other products

Trade Name	Approximate LD ₅₀ ¹ (mg/kg)	Oral Toxicity Rating	Signal Word
AAtrex 80W	5,100	IV	Caution
AAtrex 4L	1,886	III	Caution
AAtrex Nine-0	1,600	III	Caution
Accord	5,400	IV	Caution
Acme Brush Killer	2,010	III	Caution
Arsenal Applicators Concentrate	>5,000	IV	Caution
Amizine	4,000	III	Caution
Banvel 520	1,707	III	Caution
Banvel 720	1,707	III	Caution
Banvel Herbicide	2,629	III	Caution
Banvel XG	5,300	IV	Caution
Garlon 4	2,460	III	Caution
Garlon 3A	2,830	III	Danger ²
Krenite	24,000	IV	Caution
Krenite S	>5,000	IV	Warning ²
Oust	>5,000	IV	Caution
Princep 80W	15,380	IV	Caution
Princep Caliper 90	>5,000	IV	Caution
Princep 4L	>5,000	IV	Caution
Pronone 10G	>5,000	IV	Caution
Tordon K	5,000-6,000	IV	Caution
Tordon 10K	5,000	III	Caution
Tordon 101 Mixture	3,000	III	Caution
Tordon 101R	8,000	IV	Warning ²
Tordon RTU	8,000	IV	Warning ²
Trans-Vert	1,400	III	Caution
Velpar L	7,080	IV	Danger ²
Weedar 64	1,615	III	Caution
Weedone CB	2,140	III	Warning ²
Weedone 170	2,000	III	Caution
Weedone 2,4D-P	2,200	III	Caution

Other products for Comparison

Trade Name	Approximate LD ₅₀ ¹ (mg/kg)	Oral Toxicity Rating	Signal Word
Table Salt	3,000	III	-
Baking Soda	3,500	III	-
Aspirin	1,240	III	-
Caffeine	200	II	-
Gasoline	150	II	-

¹ Unless otherwise indicated, values are for the formulated product² Severe eye irritants

> Greater than

Table 3: Estimated acute oral and dermal toxicity¹ (fluid ounces) of 18 chemicals for a 175 pound person

Chemical	Oral LD ₅₀ ² (ounces)	Toxicity Category	Dermal LD ₅₀ (ounces)
Nicotine	0.02	Extremely	N/A ³
Methyl Parathion (80%) ⁴	0.03	Extremely	1.0
Caffeine	0.21	Extremely	N/A
Lindane (20%) ⁴	2	Moderately	11.0
Sevin (50%)	2	Moderately	30.0
Aspirin	3.5	Moderately	N/A
2,4-D	3-7	Moderately	4.0
Malathion (91%)	4	Moderately	12.0
Table Salt	9	Moderately	N/A
Banvel	7	Moderately	6.0
Banvel CST	14	Slightly	6.0
Garlon	7	Moderately	11.0
Tordon 101 ⁴	8	Moderately	7.0
Tordon 101R	18	Slightly	11.0
Oust	14	Slightly	6.0
Pronone 10G	14	Slightly	N/A
Accord	15	Slightly	14.0
Velpar L	20	Slightly	15.0

¹ The estimated toxicity for the pesticide is based on the formulated product (as in the container before any additional mixing)

² Most LD₅₀'s are expressed as a range reflecting experimental conditions, type carrier, test animals, and preciseness of the tests. These estimates fall within the range and are only projections based on animal tests.

³ N/A indicates nonapplicable

⁴ Restricted-use pesticides.



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