MISSISSIPPI STATE UNIVERSITY EXTENSION

Forest Herbicide Safety:

Environmental Concerns and Proper Handling

The use of herbicides in forests and other agricultural areas has caused concerns about the harm they can do to humans and the environment. Following are suggestions on environmental safety and proper procedures for handling, storing, transporting, and applying herbicides. Although there are references to specific herbicides used in forest management, the information applies to any herbicide.

Environmental Safety

Here are some ways accidents and herbicide misapplication can damage the environment:

- Mists from herbicide sprays on hot days can drift for miles in high winds and result in damage to nearby crops.
- Runoff from treated areas may impact algae, aquatic organisms, and fish.
- Careless cleaning of equipment can contaminate soil, ground and surface water, and desirable vegetation.
- Off-site application can occur if boundaries are not clearly marked and applicators are not aware of their location.

Environmental damage can result from improper herbicide use. For this reason, it is important to understand potential hazards and methods used to avoid damage.

Problems with herbicide drift are typically related to wind conditions. Drift can cause problems off-site and influence the rate of application on-site. For example, if a gust of wind moves your spray swath 20 feet during a pass, part of the targeted area will be skipped and an adjacent area will receive too much herbicide. Drift problems can be avoided with knowledge of the product, application equipment, and wind speed's effect on herbicide distribution. For example, granular formulations are less affected than liquid sprays.

Guidelines specifying "shut-down" conditions should be established for both equipment and product being used. Do not relax guidelines after a pause or shut-down. If a job is delayed because of weather, the acceptable conditions for restarting should be the same as the first day on the job.

If temperatures are expected to go above 90 to 95 degrees and you are planting sensitive crops, do not apply products that may vaporize. Since wind and temperature could cause problems during application, you must monitor and record weather conditions. Monitoring weather conditions will help the applicator know when to shut down, and records provide legal assistance if a nearby landowner files a claim.

Know the crop types and their locations, as well as their proximity to homesites, streams, ponds, and other sensitive areas. Use a pretreatment survey and a sketch map to document these potential impact areas.

Establish buffer strips around sensitive areas to protect from drift and runoff. Liability for damages resulting from application fall on the applicator, so environmental concerns are extremely significant.

Terms and Definitions

Acute toxicity: A measure of how much one exposure of a chemical can cause injury or death.

Chronic toxicity: How much a substance can cause injury or death after long-term exposure.

Dermal toxicity: How much a substance can cause injury or death if it gets through unbroken skin.

Exposure: Swallowing, breathing, or touching a chemical.

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

Herbicides: Chemicals that control plant pests.

LD_{50}: How much of a chemical (lethal dose) is needed to kill 50 percent of the test animals.

Oral toxicity: The ability of a substance to injure or kill if swallowed.

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

ppm (parts per million): How much pesticide is in water, plants, food, or animals. 1 ppm equals about 1 ounce in 62,500 pounds or 1 tablespoon in 3,906 gallons.

Toxicity: The ability of a material to injure or kill.

Measuring Toxicity

Toxicity, or how much a substance can 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 herbicide toxicity, 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, scientists learn the dosage needed to kill half (50 percent) of the animals (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 Concentrate has an LD_{50} rating of 5,400 mg/kg. That means about 1 pint of Accord in the concentrated form would have to be consumed for a 175-pound person to reach the LD_{50} dose.

This information can be very valuable. 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 an LD_{50} rating of 4,000 mg/kg.

Also, many herbicides have a lower toxicity rating than many frequently used household compounds. Many people wonder how a herbicide that is extremely effective in killing unwanted plants can have such little toxicity in humans.

Plants differ from humans in many ways. Researchers rely on those differences to make chemicals that interrupt plant functions without harming humans. For example, in a process called photosynthesis, plants produce food by using carbon dioxide from the air, water from the soil, and sunlight. Since humans can't perform photosynthesis, a chemical that blocks this process can kill plants without affecting humans.

Knowledge and manipulation of plant processes, such as blocking production of certain amino acids that only plants make, is another method that has no human effects. Although the acute LD_{50} rating may indicate a compound is fairly low in toxicity, be careful 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 mixing or applying the herbicide. The label has warnings and a list of protective clothing and equipment required when using it.

As mentioned earlier, herbicides generally interrupt plant functions. This results in herbicides typically being the least toxic of all pesticides. However, always use caution when handling concentrated herbicides. Avoid unnecessary exposure. In concentrated form, many herbicides irritate skin and can cause eye injury. Always use protective eyewear and neoprene or rubber gloves when mixing herbicides. Protective clothing includes items such as long-sleeved shirts, long pants, and water- or chemical-resistant boots.

Chemicals can enter the body through cuts or scrapes on the skin, so these must be properly bandaged before you apply chemicals. Always check equipment for leaks, and calibrate with water before application. Always stay upwind from the nozzle to avoid spray drift. Take wash water and detergent to the field in clearly marked containers. In case of spills, wash the herbicide off immediately. Take a change of clothes with you to the application site so you can change if your clothes become contaminated. After spraying, applicators should always wash their hands and face thoroughly before eating or smoking. Always wash contaminated clothing separately from noncontaminated items. Clean and thoroughly rinse all equipment after application.

The best area for cleaning is on a wood rack or a concrete apron with a good sump. A second choice is to apply the rinse water carefully where the herbicide application took place.

In all aspects of herbicide use, take care to avoid contaminating water supplies. Attention to several details can help avoid this problem. Never apply any chemical near a well or other water source. When possible, use a nurse tank to mix only the amount of herbicide needed for that day's work. When filling from a well, use a separate pump with check valves to prevent back siphoning.

Herbicide Disposal, Storage, and Transport

Disposal

After applying herbicides, properly dispose of extra chemicals and empty containers. Preventing pesticide leftovers is the best way to minimize disposal problems. Before buying a herbicide, make sure it is labeled for the intended use. Carefully estimate how much herbicide is needed, and buy only that quantity. Before mixing, check weather conditions to see if they fall within acceptable guidelines. Mix only what is needed for that day.

Proper disposal of empty herbicide containers is required. After application, triple-rinse all empty containers. Pour rinse water back into the spray tank and not on the ground. Punch holes in metal containers and cut plastic containers so they cannot be used again. Lastly, dispose of all containers at an approved site.

Storage

Properly storing herbicides is essential for safe use. Designate an area where only pesticides are to be stored. This area should be locked and all entrances prominently posted: Warning-Pesticides-Keep Out. Ideally, the storage area should be fire-resistant, including a concrete floor. The storage area should be cool and 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, group each type of herbicide. For example, group all containers of Garlon 4 together; then group containers of Accord Concentrate together. Always store containers with labels clearly displayed. It is also a good practice to store containers off the ground on wooden crates to avoid moisture problems. Keep a current inventory of all chemicals stored, including the date purchased, used, and placed in storage.

Keep storage areas clean and orderly. Have 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. Always keep a fire extinguisher in the storage area.

Transport

These precautions can be helpful in safely transporting herbicides:

- Check that containers are not damaged before loading or during transport.
- Take only the amount of herbicide needed for that day.
- Do not transport herbicides in the passenger section of vehicles. Do not transport herbicides in trunks of passenger cars. When transporting herbicides by car, use a trailer.
- Use rope and straps to secure containers to prevent movement during transport. Periodically check containers to be sure they have not shifted and spilled.
- At the application site, store containers in the shade. Direct sunlight can cause containers to overheat, building up pressure. You can also use a tarp to shade the containers.

Spill Procedures

If an accident occurs during transport and a minor spill results, give first aid to anyone who may have been injured. Then, confine the spill. If the spill starts to spread, dig a trench around the area to contain it.

Always have a shovel when hauling herbicides. Use an absorbent or clay-like material, such as the ones mentioned in the storage section, to soak up herbicides. 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), give first aid, then call the manufacturer. The number to call in case of an accident is prominently displayed on all herbicide labels. The manufacturer will indicate which authorities to notify and what procedures to follow.

Read the Label

The label is the most important source of information for safe herbicide use. It has complete information and instructions on the physical and chemical natures of the product, precautionary statements, and warnings important for proper application.

The label has detailed information on application, storage, and disposal of the product. The manufacturer's address and phone number are listed. Information regarding the brand name, chemical name, type of formulation, and EPA registration numbers are included. This information is necessary for a doctor to know in case of an accidental poisoning.

The most important time spent in herbicide application is time spent reading and understanding the label information. Always read the label four times:

1. Before buying the herbicide
2. Before preparing the material for use
3. Before applying the herbicide
4. Before storing or disposing of the herbicide

Before buying a herbicide, read the label to make sure the chemical is properly labeled for the particular job. Make sure the chemical will work in the equipment being used and under the conditions that applications will take place. Also be sure it will not cause any adverse issues specific to the site itself.

Before preparing the chemical for use, read the label for any warnings, and use any protective equipment recommended. The label details how much herbicide is needed and how it works with other chemicals or carriers, such as diesel fuel. Also, labels give the post-application waiting period for crops and animals, the rate and methods of application, and any restrictions.

Reading the label before storing or disposing of the product helps determine where and how to store the chemical, and the correct method to dispose of empty containers or leftover product.

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

[1]For the labeled product.

Summary

Herbicides are both useful and efficient when used properly. Herbicide applicators must know the correct way to use them. The herbicide label is the primary source for this information. If, after reading the label, you are uncertain about something, stop and get help. There are many sources of information, including your county Extension office and the people who make and distribute herbicides.

When using herbicides, remember: Read the label, and when in doubt, stop and get help.

Table 2. Oral toxicities of silvicultural herbicides and other products.

Trade name	Approximate LD_{50}[1] (mg/kg)	Oral toxicity rating	Signal word
Accord Concentrate	5,400	IV	Caution
Arsenal Applicators Concentrate	>5,000	IV	Caution
Chopper Gen2	>2,000	III	Caution
Escort XP	>5,000	IV	Caution
Garlon 4	2,460	III	Caution
Garlon 3A	2,830	III	Danger[2]
Krenite S	>5,000	IV	Warning[2]
Oust XP	>5,000	IV	Caution
Pronone Power Pellet	1,690	III	Caution
Tordon K	5,000–6,000	IV	Caution
Tordon 10K	5,000	III	Caution
Tordon 101 Mixture	3,000	III	Caution
Tordon RTU	8,000	IV	Warning[2]
Velpar L	7,080	IV	Danger[2]

Table 4. Other products for comparison.

Trade name	Approximate LD_{50}[1] (mg/kg)	Oral toxicity rating	Signal word
Table salt	3,000	III	n/a
Baking soda	3,500	III	n/a
Aspirin	1,240	III	n/a
Caffeine	200	II	n/a
Gasoline	150	II	n/a

[1]Unless otherwise indicated, values are for the formulated product.
[2]Severe eye irritant.

Table 3. Estimated acute oral and dermal toxicity (fluid ounces) of 17 chemicals for a 175-pound person.

Chemical	Oral toxicity LD_{50}[1] (ounces)	Category	Dermal LD_{50}[2] (ounces)
Nicotine	.02	Extremely	N/A
Methyl parathion (80%)[3]	.03	Extremely	1
Caffeine	.21	Extremely	N/A
Lindane (20%)[3]	2	Moderately	11
Sevin (50%)	2	Moderately	30
Aspirin	3.5	Moderately	N/A
2,4-D	3–7	Moderately	4
Malathion (91%)	4	Moderately	12
Table salt	9	Moderately	N/A
Garlon	7	Moderately	11
Tordon 101M	8	Moderately	7
Pronone Power Pellet	4.7	Moderately	5.6
Oust XP	14	Slightly	6
Accord Concentrate	15	Slightly	14
Velpar L	20	Slightly	15

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

[2]Most LD_{50} amounts are expressed as a range reflecting experimental conditions, type carrier, test animals, and how accurate the tests are. These estimates fall within the range and are only projections based on animal tests.

[3]Restricted-use pesticides.

Publication 1874 (POD-05-23)

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