

A Manual on

Ground Applications of Forestry Herbicides

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CHAPTER 8

MINIMIZING APPLICATOR EXPOSURE

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Everyone who applies or in some manner comes in contact with herbicides will share a common interest, concern, or apprehension about exposure to these materials. This chapter addresses these concerns and shows that you can, if you choose, significantly decrease your exposure.

Research shows that nearly everyone who works with herbicides receives some exposure. These same studies also show that workers can safely use herbicides if they follow the guidelines prescribed. Some field operating procedures can significantly decrease your exposure. Pay attention to your own actions — personal habits, cleanliness, sloppiness, etc. They may govern your level of exposure.

HERBICIDE ENTRY INTO THE BODY

Contrary to earlier theories, herbicides enter the body mainly through the skin, and not the nose. The nose remains a factor, of course; it is highly sensitive to low levels of airborne herbicide. Moreover, large volumes of air are inhaled by field workers. Nevertheless, the amount of herbicide entering the body by the nose is insignificant compared to the amount entering the body through the skin.

The skin of most humans is not highly sensitive to most herbicides. Therefore, skin contact and consequent entry into the body is not obvious. The higher the concentration and the longer an organic herbicide remains on the skin, the more that is absorbed. Persons handling or mixing the concentrated liquid formulations are most likely to absorb it through the skin.

PROTECTIVE CLOTHING

The mixer's hands ordinarily receive more than 90 percent of the total exposure. Thus, it is especially important for these workers to wear clean, chemically impervious gloves. To prevent inadvertent contamination of the hands, take extreme care when removing rubber gloves or when you put on previously contaminated gloves. Rubber-coated gloves can be washed before removing to minimize the exposure of handling the gloves and putting them back on. Make sure that the rubber coating on cloth gloves covers the absorbent wrist band.

Immediately and thoroughly wash the skin if it comes in contact with herbicide concentrates. This is a *must* for anyone, to minimize the amount of herbicide entering the body.

Be extra careful if you wear leather gloves or leather boots that were previously used while working with herbicides or other pesticides. You may be likely to continuously expose yourself to low levels of these compounds. Boots should be frequently sealed with silicone and wax-type sealers to prevent absorption.

Cover bare skin with freshly laundered clothing to decrease herbicide absorption into the body. Where feasible in cool weather, wear clothes especially designed for protection against chemicals. These clothes can markedly decrease exposure. In hot climates, the "nonbreathing" fabric making up the protective clothing may render this clothing impractical (and dangerous due to potential heat prostration).

Workers using backpack sprayers receive high exposure because their clothing often becomes moist due to a combination of morning dew, perspiration, and the liquid spray-mixture. Moist clothing, including gloves, may serve as a continuing reservoir of herbicide available for skin absorption. Thoroughly showering as soon as possible after using the backpack will significantly reduce the amount entering the skin. Only the amount of herbicide entering the body can have any adverse health implications.

WHAT WE KNOW

Considerable progress has been made in the past 10 years, through monitoring exposure, to develop ways to decrease our exposure to pesticides. However, it has been much more difficult to clearly demonstrate the significance of pesticide exposure to short-term and long-term health. Following are some facts that we know:

1. There is a very wide range in the toxicity ratings among the 200-plus different pesticides in existence.
2. Herbicides as a group are less toxic than insecticides to humans and most other mammals.
3. Workers using the more toxic organic phosphate insecticides appropriately take more precautions than do workers applying less toxic herbicides.
4. Many herbicides, once absorbed into the body, are rapidly excreted in the urine. Studies show that compounds like 2,4-D, dichlorprop, and picloram are not stored in the body. The body has several built-in safety devices for eliminating or detoxifying these compounds.
5. Many workers have used herbicides over 20 years with no known ill effects to their health. Claims of worker illness due to exposure to herbicides have not been confirmed. When used according to label instructions, herbicides are not

considered harmful to human health.

A degree of risk is associated with almost everything we do. In an attempt to put into perspective the amount of cancer risk associated with phenoxy herbicides consider the following:

- If you smoke two packs of cigarettes daily your cancer risk is 6,000 times greater than that of a male herbicide applicator working for 40 years.
- The cancer risk associated with being in a room with a smoker is 50 times greater than that faced by a man who applies phenoxy herbicides over a 40-year career.

Irrespective of the amount of risk involved, you should limit your exposure when possible. Follow these guidelines to decrease the amount of herbicide penetrating the skin:

1. Read and obey the label.
2. Be aware that you can decrease your exposure.
3. Wear clean clothing (shirt, trousers, boots, and gloves).
4. Avoid eating, using the bathroom, or use of tobacco when hands are contaminated.
5. Wash hands or other exposed skin immediately after exposure.
6. Shower as soon as possible after potential exposure.

MOST OFTEN ASKED QUESTIONS

This section answers 16 questions often asked by forestry personnel working with herbicides and other pesticides.

1. Q. Can we safely use herbicides?

A. Several studies over the past 10 years have measured the extent of exposure of workers who

mix and apply herbicides. These studies have revealed several ideas that can be readily used by all who truly desire to limit their exposure. These studies indicate that interested, informed workers can safely use herbicides.

2. Q. How is exposure most likely to occur?

A. Individuals who mix concentrates, unplug spray nozzles with their bare hands, or apply herbicides with backpack sprayers are the most likely to be exposed. Herbicide contact with bare skin is the most common exposure route. Therefore, almost any means of covering bare skin is likely to decrease exposure. Do not wear cloth gloves because they can soak up herbicides. Contaminated gloves can serve as a continuous wick, allowing the chemical to move to the skin surface. Although inhalation is less likely than skin contact, there are instances where a respirator can help limit exposure.

3. Q. How would I know if I was exposed?

A. Most workers mixing or applying pesticides will be exposed to low levels of the compound they are using. Fortunately, the body has mechanisms to rid itself of toxins or other contaminants. Thus, most of the newer pesticides, even if they get in the body, do not build up in the body. Only those individuals who are highly sensitive to pesticides, plastics, or other petroleum products would be aware of exposure. Most pesticides used in forests have only low toxicities. Therefore, it is highly unlikely that anyone following pesticide label instructions has received health-threatening levels.

4. Q. What effects should I expect if I get the spray mixture or the concentrate on me?

A. Although you should avoid exposure to pesticide concentrate, workers have on several occasions been inadvertently exposed with no ad-

verse effects. Ordinarily, a rapid, thorough washing of the exposed area will remove the pesticide. Other than slight skin irritation for some workers, no additional effect would be expected. Concentrated chemicals of any kind can irritate the skin and are a real threat to unprotected eyes.

5. Q. Is breathing the spray harmful to me?

A. No one should intentionally breathe fumes, smoke, or sprays of any kind. It is reassuring to know that although the nose can sense low levels of many pesticides, the actual amount that you inhale is very low compared to the amount entering through the skin. The skin is the major entry route of exposure. However some herbicides, such as paraquat and diaquat (not currently labeled for forestry uses), are particularly irritating to the lungs. Therefore, special precautions should be taken to prevent inhalation of these herbicides.

6. Q. Will my exposure in any way hurt my family—those living now or those to be born in the future?

A. There is no scientific evidence that herbicide exposure causes human birth defects. Rapid and often nearly total excretion is common for many pesticides that enter the body. Therefore, it is not surprising that these compounds do not build up in the body. Some older insecticides such as DDT and heptachlor remained in fatty tissues. Since the newer pesticides contain different chemicals, they are more readily excreted in urine or feces. These compounds cause no lingering effects after they are eliminated from the body. Avoid the possibility of contaminating your family or home with clothing that you have worn while working with pesticides—remove contaminated clothes before, or as soon as, you get home. If you know the clothing is contaminated, wash it separately from the other laundry. Use hot water and soap or detergent in your washing machine to produce a clean set of clothing.

7. Q. Compared to exposure to cigarette smoke, how dangerous is my exposure to herbicides?

A. Cancer researchers provided an answer based on a male who sprayed 2,4,5-T with a backpack applicator during a 40-year career. He would have a cancer risk factor only 1/6000 as high as that of a 2-pack-a-day smoker. The researchers offer other interesting calculations. If you eat 4 tablespoons of peanut butter per day your cancer risk is 200 times greater than that of the same man who repeatedly sprayed 2,4,5-T during his 40-year career. According to these calculations you are not taking a large risk if you follow label instructions and safety guidelines.

8. Q. If herbicide exposure is not overly dangerous, why do we continue to read and hear about concerns regarding human exposure to pesticides?

A. Articles appearing in newspapers and on TV are not required to have scientific facts backing their statements. We have many freedoms in our country, including those which allow an individual to express his opinion. There is agreement among many reputable scientists that herbicides, when used properly, do not pose large health risks to humans. This statement is true for applicators and mixers as well as those who must work in or near a treated area. Improper facts and a common fear of all pesticides and "synthetic" compounds sometimes contribute to confusion in these issues.

9. Q. What can I do to protect myself from exposure?

A. The most correct and simple answer to this question depends on your specific duties. Mixers of herbicide who get concentrate on their skin in any manner and backpack applicators whose clothing get soaked during application will receive the most exposure. Any means that can be used to keep the herbicide from contacting bare skin areas will be highly effective in limiting exposure to the skin and consequent absorption through the skin

and into the body. Remember: absorption through the skin occurs rapidly *even though* you cannot feel any burning or other sensation. Thus, it is important to *quickly* and *thoroughly* wash any skin area that has in been contact with a pesticide. Protective clothing can markedly reduce exposure. If your clothes become soaked with the concentrate or spray mix, a shower and clothing change will limit exposure. Often humans have received relatively high exposures to herbicide concentrates without reporting any ill effects. The body quickly eliminates in urine many of the herbicides commonly used in the forest. The fact that these compounds are excreted rapidly and do not build up in the body probably contributes to the excellent safety records these compounds have had over the past 30 years.

We should not abuse our bodies by unduly exposing the skin areas to pesticides, but it is reassuring to know that our bodies do have built-in safety devices to help us cope with things such as caffeine in coffee, nicotine in cigarettes, or herbicide exposure.

10. Q. Herbicides are highly toxic to some green plants. How can I be sure they won't be toxic to me?

A. Herbicides are specifically designed in the laboratory to kill weeds. Some, such as 2,4-D and Tordon, are designed to selectively control broadleaved plants. They have little effect on animals when used as directed. Insecticides are designed in the laboratory to kill insects. Since insects are a part of the animal kingdom, perhaps that is the reason that many insecticides are more toxic to humans than are herbicides. Even the more highly toxic pesticides can be safely applied by humans if the proper precautions are followed. When using any chemical, including gasoline, oil, kerosene, lighter fluid, or any organic solvent, one should take care to prevent skin contact. Although uptake through the skin is the major route of entry into the body, avoid inhaling pesticides or swallowing them with food.

11. Q. As an applicator, am I taking a major risk by repeatedly exposing my body to herbicides?

A. Due to their relatively low toxicity and since herbicides are rapidly excreted and do not build up in the body, no major risk is being assumed. From evaluation of results from studies on applicator exposure to herbicides it appears that the more exposure that occurs the higher the amount of herbicide that is excreted. These scientific evaluations agree with the observations that many individuals have repeatedly applied herbicides over many years with no health problems due to their exposure.

12. Q. What danger do I risk if I must walk through or work in areas that have been treated with herbicides?

A. Research shows that little to no exposure occurred when a worker walked through an area treated with 2,4,5-T. The area had been sprayed by helicopter 1 hour earlier. This area had hip-high to head-high weeds, but the spray had dried during the 1 hour interval between spraying and walking through the area. Another example involved an individual who was inadvertently in the spray path of a helicopter applying 2,4-D. He received much, much less exposure than did the helicopter pilot or the workers mixing the concentrate.

13. Q. Can a numerical value be put on the question, "How safe is this chemical?"

A. One way to measure the effect of pesticides on human safety employs a term called *margin of safety*. For example, a margin of safety of 50 means that a worker could have absorbed 50 times more chemical than he or she did without suffering any observable effect. Margins of safety are derived by comparing the highest amount of a herbicide that can be added to the daily diet of a sensitive laboratory rat without causing an observable effect. This amount is called the *No Observed Effect Level* (NOEL). A margin of safety for a herbicide application is calculated by dividing the

NOEL determined with lab animals by the average amount of herbicide excreted in the urine of an exposed applicator. The following are some margin-of-safety (MOS) values for a 2,4-D study in the Pacific Northwest. Workers in the study wore new rubber gloves, new boots, and followed good safety rules.

Worker	MOS
Helicopter pilot	2,810
Mechanics	7,973
Refiller	1,714
Supervisor	184,615
Observers	266,667*

*The observers were 500 feet from the spray-mixing site.

In a ground applicator exposure study using 2,4-D and picloram, the average MOS for 2,4-D ranged from 245 for a backpack crew to 5,581 for an injection bar crew. Picloram's MOS ranged from 23,000 for Hypo-hatchet's to 943,400 for injection bars. The primary reason for the large picloram MOS is that this herbicide does not readily penetrate the skin.

Of the 80 herbicide applicators monitored, the most exposed one, a backpack sprayer, had a MOS of 98. Although his clothing appeared to be nearly saturated with spray, these calculations indicate he could have received 98 times as much 2,4-D and still be below a dose level harmful to his health even if he was repeatedly exposed in a similar manner.

14. Q. What kind of gloves and boots should I wear?

A. Gloves made of material that keeps out water and chemicals will provide a good measure of protection for the hands—even the wrist band

should be sealed. More than 90 percent of the total exposure to pesticides occurs to the hands. Therefore, the surest way to limit your exposure is to take care to protect your hands. Improper removal of gloves can contaminate the inside part of the gloves; thus, re-use of contaminated gloves could subject your hands to a continuous high exposure. Wash gloves before removing. *Remember:* many compounds can penetrate the skin without your awareness. Any uncontaminated boots that are impervious to water or organic chemical can be safely worn. Treatment of leather boots with a sealing agent can prevent chemical passage through the boot to the foot. Contaminated leather gloves or boots can serve as a continuing source of herbicide exposure—so beware.

15. Q. What kind of eye protection should be used?

A. Following label instructions is the first

guideline. Some herbicides are more dangerous to the eyes than others. Treat eye exposure to herbicides by a rapid, thorough and somewhat continuous flushing with clean water. Then see a physician. Goggles or safety-glasses that have side shields are a requirement when you use many compounds. Eye protection is essential for anyone who is mixing concentrates.

16. Q. Is it possible that I am more sensitive to herbicides than are others in my work group?

A. Some people are very sensitive to poison ivy and others are nearly immune. Similar variations exist for hay fever and mosquito bites. Similarly, it would not be surprising for some individuals to be more sensitive to herbicides. Those who are known to be more sensitive should employ greater safety measures or perhaps assume a duty where exposure is less likely to occur.