

# Pesticides: Routes of Exposure<sup>1</sup>

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## Introduction

Pesticides are designed to be toxic to living organisms so that unwanted pests can be controlled. Though pesticides are also toxic to humans, they vary significantly in the hazards they present. In many respects, living organisms are not all that different from one another, and something that is toxic to one species may also be toxic to other organisms. This is especially true if the organisms are related. For example, insects, rodents, and humans are all animals and have similarities in their nervous, circulatory, and respiratory systems. These similarities are the reasons that pesticides can affect people.

Pesticides can cause both short-term and long-term effects in humans. Refer to the signal word on the product label and the information contained in the “Hazards to Humans and Domestic Animals” section included in the “Precautionary Statements” section of the label to learn more about human toxicity concerns. More specific and detailed toxicity information may be found in the product’s safety data sheet (SDS). Products can also pose physical and chemical risks if they are explosive and combustible. If the product presents either a physical or a chemical hazard, this information is included under the “Precautionary Statements.”

Pesticides must make contact with the target pest to cause an effect; likewise they must do so to adversely affect humans. Human exposure to pesticides can happen through four major routes. Pesticides can enter the body orally (through the mouth and digestive system), ocularly

(through the eyes), dermally (through the skin), or by inhalation (through the nose and respiratory system).

## Oral Exposure

Oral exposure may occur because of an accident, but is more likely to occur as the result of carelessness, such as blowing out a plugged nozzle with your mouth, smoking or eating without washing your hands after using a pesticide, splashing concentrate while mixing, or eating fruit that has been recently sprayed with a pesticide that contains residues above the tolerance set for the commodity by the Environmental Protection Agency. The seriousness of the exposure depends upon the oral toxicity of the material and the amount swallowed.

Accidental oral exposure occurs frequently when children have access to rodent baits or other improperly stored pesticides in the home or when pesticides have been taken from the original, labeled container and put into an unlabeled bottle or food container. Unfortunately, children are the most common victims of these mishaps. Mark all pesticide measuring cups and containers to ensure that no one uses them for water, drink, or food. Never store pesticides in beverage or other food containers.

## Dermal Exposure

Dermal (skin) exposure accounts for about 97 percent of the exposure to pesticide users from non-fumigant pesticides. It may occur any time a pesticide is mixed, applied, or handled, and it often goes undetected. Skin exposure may

1. This document is PI260, one of a series of the Agronomy Department, UF/IFAS Extension. Original publication date December 2015. Visit the EDIS website at <http://edis.ifas.ufl.edu>.

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also result from contact with pesticide residues on treated surfaces or contaminated equipment during cleaning or repair. The seriousness of dermal exposure depends upon:

- the dermal toxicity of the pesticide,
- the rate of absorption through the skin,
- the size of the skin area contaminated,
- the length of time the material is in contact with the skin,
- the amount and concentration of pesticide on the skin.

Rates of absorption through the skin are different for different parts of the body. Using absorption through the forearm as the standard, absorption of parathion is over 11 times faster in the lower groin area than on the forearm (Table 1). Absorption through the skin in the genital area is rapid enough that it approximates the effect of injecting the pesticide directly into the bloodstream.

**Table 1. Parathion absorption rates through the skin on various bodily regions.**

Body region	Percent relative absorption
Forearm	8.6
Palm of hands	11.8
Ball of foot	13.5
Abdomen	18.4
Scalp	32.1
Forehead	36.3
Ear canal	46.5
Genitalia	100

Absorption continues to take place on all of the affected skin area as long as the pesticide is in contact with the skin. The seriousness of the exposure is increased if the contaminated area is large or if the material remains on the skin for a period of time.

Pesticide formulations vary in their ability to penetrate skin. In general, water-soluble liquids or powders, wettable powders, dusts, and granular pesticides do not penetrate skin very easily. However, oil- or solvent-based liquid formulations such as emulsifiable concentrates are readily absorbed, and wettable powder and emulsifiable concentrate products have a higher concentration of active ingredient than dusts and granules.

Application techniques can also affect exposure levels for applicators. Making overhead applications, using blower application equipment for mists and dusts, using animal pour-ons, or dipping livestock and pets are all application methods that tend to have high dermal exposure levels. Contaminated hands or gloves can transfer pesticides to

other body parts. A reminder about personal hygiene: be sure to wash your hands and gloves after each pesticide handling event.

## Inhalation Exposure

Inhalation exposure results from breathing pesticide vapors, dust, or spray particles. Like oral and dermal exposure, inhalation exposure is more serious with some pesticides than with others, particularly fumigant pesticides, which form gases.

Inhalation exposure can occur by breathing smoke from burning containers, breathing fumes from pesticides while applying them without protective equipment, and inhaling fumes while mixing and pouring pesticides. Some pesticides will have statements on their labels requiring the use of a specified respirator. Inhalation exposure can also result from smoking tobacco products containing pesticide residues. Once breathed into the lungs, pesticides can enter the bloodstream very rapidly and completely, eventually resulting in damage to other body organs.

## Ocular Exposure

The tissues of the eye are extremely absorbent. Blood vessels are very close to the surface of the eye, so pesticides can be easily absorbed into the bloodstream. Under certain conditions and using certain pesticides, absorption through the eyes can be significant and particularly hazardous. Eyes are very sensitive to many pesticides and, for their size, are able to absorb surprisingly large amounts of chemicals. In addition to systemic concerns, some products are corrosive and can cause severe eye damage or even blindness. Serious eye exposure can result from airborne dusts or particles, splashes or spills, broken hoses, spray mists, or from rubbing the eyes with contaminated hands, clothing, or PPE, such as unwashed gloves.

## Additional Information

Fishel, F.M. 2005. *Understanding Safety Data Sheet Language*. PI35. Gainesville: University of Florida Institute of Food and Agricultural Sciences. <https://edis.ifas.ufl.edu/pi072> Accessed September 2015.

Nesheim, O.N., F.M. Fishel, and M.A. Mossler. 1993. *Toxicity of Pesticides*. PI13. Gainesville: University of Florida Institute of Food and Agricultural Sciences. <https://edis.ifas.ufl.edu/pi008> Accessed September 2015.