L-1167

XXXXXXXXXXXXXXXX

# Pesticide Exposure...

# PROTECTIVE MEASURES

XXXXXXXXXXXXXXXX

TEXAS A&M UNIVERSITY
TEXAS AGRICULTURAL EXTENSION SERVICE
J. E. Hutchison, Director, College Station, Texas

# Pesticide Exposure... Protective Measures

Jack D. Price*

Chemicals used as pesticides are toxic (poisonous) and care must be exercised to avoid accidental poisoning. Minimizing exposure to chemicals is an essential element of safe use. A review of the exposure routes illustrates the importance of taking proper precautions and using proper protective measures when working with chemical pesticides. Chemicals may enter the body through dermal (skin), respiratory (lungs) and oral (mouth) routes (figure 1).

**Dermal exposure.** The dermal route is the most important one during exposure situations in the field, in handling and in formulating. Percutaneous (skin) absorption is the probable route of entry in nearly 80 percent of the occupational poisoning cases by industrial and agricultural chemicals in one western state. Occupational poisoning by various pesticides is more closely related to their acute dermal toxicity than to their acute oral toxicity.

Factors affecting dermal absorption include:

- the pesticide's physical and chemical properties
- health and condition of the skin
- temperature
- humidity
- presence of other chemicals (solvents, surfactants, etc.)
- pesticide concentration
- type of formulation
- skin site (i.e., forehead, forearm, crotch, etc.)

Persons with skin conditions should avoid exposure to pesticides unless extra precautions are taken to minimize dermal exposure. Similarly persons with cuts, abrasions, scratches, scuffs or any other skin damage or disruption should exercise extra care to minimize exposure to those areas.

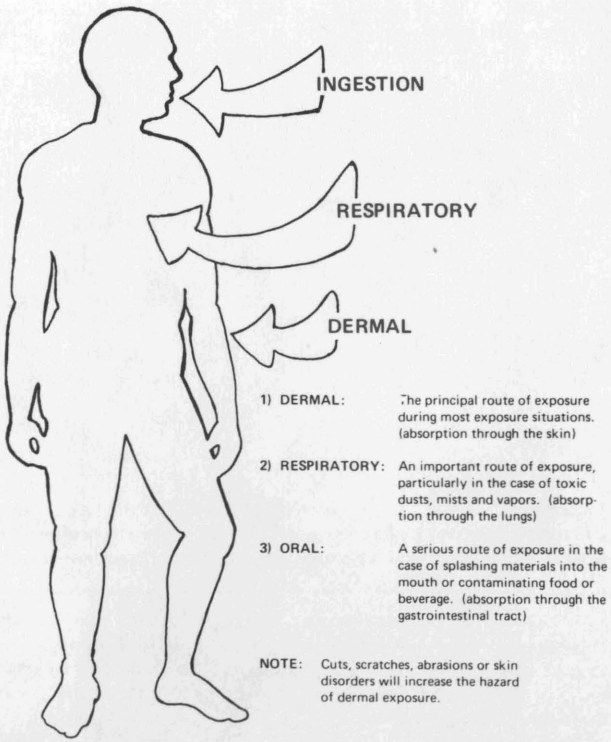
---

*Extension leader-agricultural chemicals, Texas A&M University.

Other factors affecting dermal exposure include wind, type of activity, application method, application rate and duration of exposure. Of these factors, wind is a most important environmental condition studied as an exposure determinant. Effect of wind varies according to size of spray droplets and is probably maximal in the mist produced by air blast machines used in orchards, during aerial application and when applying dust formulations. Loaders and flaggers are subject to relatively high levels of dermal exposure and, of course, indoor spraying can be extremely hazardous in terms of dermal exposure. Other activities resulting in dermal exposure include maintenance and repair of contaminated equipment and contact with treated surfaces. Parathion, for example, apparently can be fairly stable on and in equipment. Poisoning from contact with treated plant surfaces has been reported. Hand harvesting, thinning, cultivating, irrigating and insect scouting can result in sufficient dermal exposure to

## ROUTES OF EXPOSURE

**FIGURE 1**



result in poisoning, particularly among workers entering fields too soon following pesticide applications.

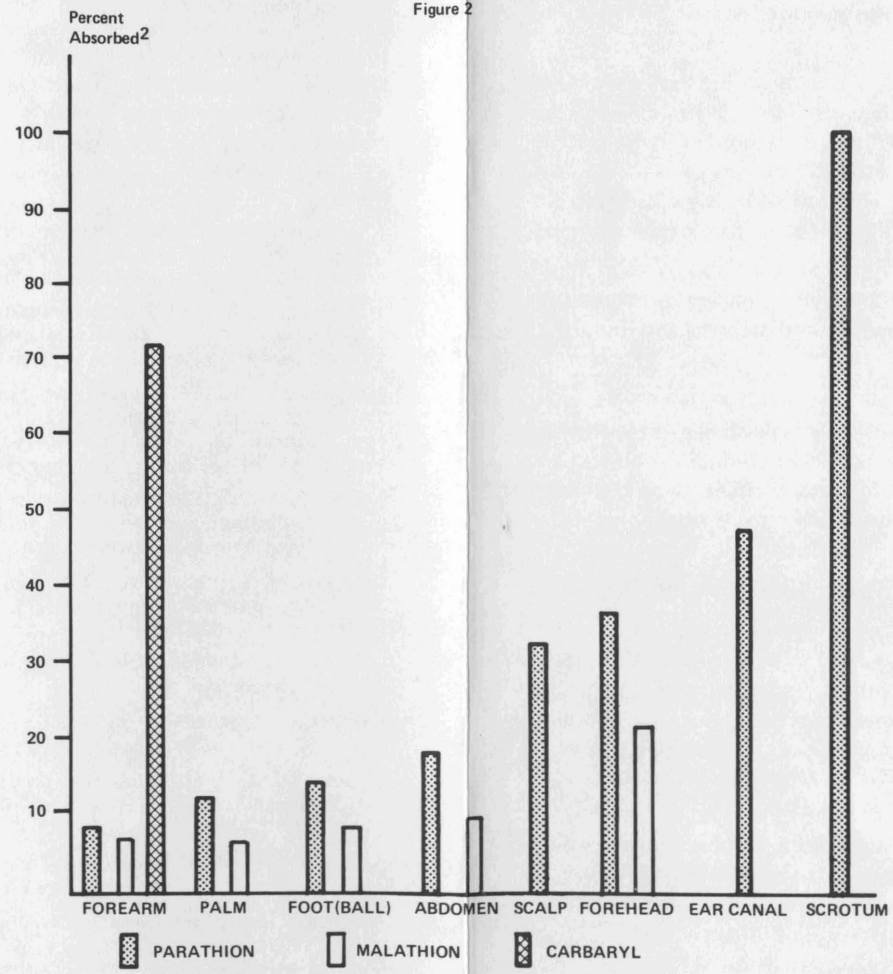
Absorption through the skin can occur directly through intact skin, apparently through the hair follicle, and disrupted skin. Differences in absorption rate through the skin of the forearm, palm, forehead, scalp, etc. are known to occur (figure 2).

The following suggestions are intended as a guide to protective measures that will minimize dermal (skin) exposure:

1. Observe recommended protective measures specifically mentioned on the label.
2. Cover up before exposure, not after. Covering contaminated skin with a thin plastic wrap has caused a fourfold increase in parathion absorption.

ABSORPTION OF INSECTICIDES APPLIED TO SKIN[1]

Figure 2




[1] Adapted from Maibach et. al. 1971.

[2] Measured indirectly as corrected urinary recovery in percent of dose applied to skin.

3. Use clean clothing daily and bathe (shower) at least daily.

4. A wide-brimmed hat, preferably waterproof, offers protection from downward drift for face and neck areas. Contaminated hatbands can present a problem; thus, use an inexpensive hat that can be discarded after minimal use or one with a replaceable hatband.

5. Wear unlined, natural rubber, gauntlet gloves for best protection. Prevent contamination of the inside of the gloves.

6. A long-sleeved, light-colored, washable cloth jacket, preferably water-repellant, is desirable. Disposable paper jackets have been tested and apparently are suitable except in heavy wetting.

7. If exposure to the lower trunk and legs is anticipated (mixing, loading, etc.), a waterproof apron is essential.

8. Use waterproof shoes or boots. Leather shoes crack after a few wettings and thus are penetrated easily. Canvas shoes also become wet and are a constant source of dermal exposure.

9. Shield the eyes to avoid contamination, particularly if splashing may occur (mixing, loading, etc.). Plastic shields or masks generally are tolerated better by agricultural workers than are goggles.

In view of the potential hazard of poisoning via dermal exposure, suggested protective measures become more meaningful. One should not, however, ignore the possibility of exposure either orally or through respiration. While exposure through these routes is generally much less than through dermal exposure, the pesticide is much more readily absorbed through these routes.

**Oral route.** Accidental splashing or transfer of pesticides to the mouth through inadvertent actions such as wiping one's face on the sleeve, cuff or hand are probably the most likely means of ingesting pesticides. Other means include food handled with contaminated hands; food exposed to spray, dust or spills of pesticides; contaminated drinking utensils and attempting to clear nozzles by blowing through the orifice. Although not

considered a major source of occupational exposure to pesticides, absorption through the gastrointestinal tract is generally more efficient than through the skin. Minimize exposure, of course, whenever possible, thus reducing total exposure.

Oral exposure can be minimized by the following steps:

1. Check the label for special instructions or warnings regarding oral exposure.
2. Never eat or drink while spraying or dusting.
3. Wash thoroughly with soap and water before eating or drinking.
4. Do not touch lips to contaminated objects or surfaces.
5. Do not wipe the mouth with hands, forearm or clothing.
6. Do not expose lunch, lunch container, beverage or drinking vessel to pesticides.
7. If involved in operations that may result in splashing of pesticides, wear a full-face, plastic shield or mask.

**Respiratory route.** The potential hazard of respiratory exposure is great because near complete absorption of pesticides occurs through this route. Vapors and extremely fine particles represent the most serious potential of respiratory exposure. Airborne contaminants of about 10 microns or less (those representing a high potential of respiratory exposure) include pesticide dusts, aerosols, fog, fumes, smoke and certain mists. Application in confined spaces also contributes to an increased potential respiratory exposure.

Respiratory protection can be provided by various types of respirators. Respirators are uncomfortable to wear, particularly in the hot and often dusty conditions encountered in pesticide application. Because of the discomfort, persons must fully realize the need for protection or they will not wear them.

Most respirators used in pesticide operations are air purifying. Respirators remove contaminants from the air by filtering or by chemical absorption or adsorption.

Filters remove particles by physical trapping as air is inhaled. Mechanical filter respirators do not provide protection against gases, vapors or oxygen dificiency. Different classes of mechanical filter respirators are available, thus providing economical and efficient

protection against specific particulate hazards. In pesticide operations, the pesticide may vaporize. Thus, if a respirator other than a filter type is called for on the label of a pesticide, there undoubtedly is a sound reason.

Chemically removing a contaminant from the air is characterized by a cartridge or cannister housing the chemical. Chemicals used in respirators for pesticide protection function in one of two ways:

1. **Adsorption** - The contaminant is adsorbed to the chemical's surface in the cannister. Activated alumina, molecular sieves, silica gel, etc. are commonly used. Certain contaminants require specific types of adsorbents.
2. **Absorption** - Absorption involves a chemical reaction between the chemical in the cannister and the contaminant in contrast to the surface attraction involved in adsorption. A chemical reaction takes place between the two generally on the surface of the chemical in the cannister.

These means of purifying air are employed in chemical cartridge respirators and gas masks.

No matter how well a respiratory device is designed and made, unless it is properly maintained, it may fail to provide protection. The two most common problems are (1) failure to occasionally wash the face-piece with soap and water and (2) neglecting to change the filter cartridges regularly.

Observe the following suggested practices:

1. Read the label. If a respirator is required, the information will appear on the label including the type that will meet the particular need. In fumigation or applying highly toxic pesticides in confined spaces, a respirator with a special compressed air supply tank is suggested.
2. Check the face-piece for cracks, hardening and elasticity of straps. A good seal is essential.
3. Change filters twice a day and whenever breathing becomes difficult.
4. Change cartridges after 8 hours of actual use and whenever any odor of the pesticide is detected.
5. Remove filters and cartridges and wash the face-piece with soap and warm water after

use. Rinse thoroughly to remove traces of soap. Dry with a clean cloth that is not contaminated with the pesticide. Place the face-piece in a well-ventilated area to dry.

6. Store the respirator, filters and cartridges in a clean, dry place, preferably a tightly closed paper or plastic bag.

## SELECTED REFERENCES


Birmingham, D. J. 1958. Occupational dermatosis - their recognition control and prevention in the industrial environment - its evaluation and control. U.S. Department of Health, Education and Welfare. pp. B-30-1 to B-30-8.

De Grozs, I. 1969. Chemical burns of the eye due to pesticides. Ophthalmologica. 158:136-140.

Deichmann, W. B. 1967. Safe handling and use of organic phosphate pesticides. Ind. Med. and Surg. 36:267-274.

Finley, E. L. and Rogillio, F. R. B. 1969. DDT and methyl parathion residues found in cotton and cotton-polyester fabrics worn in cotton fields. Bull. Environ. Cont. & Toxicol. 4: 343-351.

Fredriksson, T. 1961. Percutaneous absorption of parathion and paraoxon. IV. Decontamination of human skin from parathion. Arch. Environ. Hlth. 3:185-188.

Fredriksson, T. 1961. Studies on the percutaneous absorption of parathion and paraoxon. II. Distribution of $^{32}$p-labeled parathion within the skin. Acta Dermato-Verereologica. 41: 344-352.

Fredriksson, T. 1961. Studies on percutaneous absorption of parathion and paraoxon. III. Rate of absorption of parathion. Acta Dermato-Verereologica. 41: 353-362.

Ganelin. R. S.; Mail, G. A.; and Cueto, C., Jr. 1964. Hazards of equipment contaminated with parathion. Arch. Environ. Hlth. 8: 826-828.

Glidden, G. M. 1964. How your gas mask cannister works. *Pest Control.* pp. 1-4.

Hayes, W. J., Jr. 1954. Agricultural Chemicals and Public Health. Public Health Reports. 69: 839-898.

Hayes, W. J., Jr. 1971. Studies on exposure during the use of anticholinesterase pesticides. Bull. Wld. Hlth. Org. 44 277-288.

Kay, K. 1964. Environmental toxicology in industry and agriculture. Arch. Environ. Hlth. 8: 681-699.

Maibach, H. I.; Feldmann, R. J.; Milby, T. H.; and Serat, W. F. 1971. Regional variation in percutaneous penetration in man. Arch. Environ. Hlth. 23: 208-211.

Noakes, D. N. and Sanderson, D. M. 1969. A method for determining the dermal toxicity of pesticides. Brit. J. Ind. Med. 26 (1): 59-64.

Quinby, G. E. and Lemmon, A. B. 1958. Parathion residues as a cause of poisoning in crop workers. J. Am. Med. Assoc. 166: 740-746.

Scheupleen, R. and Ross, L. 1970. Effects of surfactants and solvents on the permeability of epidermis. J. Soc. Cosmet. Chem. 21: 853-873.

Starr, H. G. and Clifford, N. J. 1971. Absorption of pesticides in a chronic skin disease. Arch. Environ. Hlth. 22: 396-400.

Wolfe, H. R.; Durham, W. F.; and Armstrong, J. F. 1967. Exposure of workers to pesticides. Arch. Environ. Hlth. 14: 622-633.

Wolfe, H. R. 1971. Protection of workers from pesticide exposure. Proc. of the training course "Pesticides and Public Health (Advanced)". January 18-20, 1971. Atlanta, Georgia. pp. 117-128.

Wolfe, H. R.; Armstrong, J. F.; and Durham, W. F. 1966. Pesticide exposure from concentrate spraying. Arch. Environ. Hlth. 13: 340-344.

*Educational programs conducted by the Texas Agricultural Extension Service serve people of all ages regardless of socio-economic levels, race, color, sex, religion or national origin.*

---

Cooperative Extension Work in Agriculture and Home Economics, Texas A&M University and the United States Department of Agriculture cooperating. Distributed in furtherance of the Acts of Congress of May 8, 1914, as amended, and June 30, 1914.
10M—5-73 CHEM