



## APPLICATOR EXPOSURE TO PESTICIDES

When mixing, loading, or applying pesticides, applicators can be exposed by oral, dermal (including eyes), or respiratory routes. Oral exposure occurs when the mouth is open and pesticide enters the mouth and is swallowed. Spray droplets, mists, splashes, and ruptured hoses are examples of how this can happen. Generally under normal operating conditions this is considered the least likely route of exposure. Between the dermal and respiratory routes of exposure, which is the more significant exposure route for pesticide applicators? Several research projects have shown that for pesticide applicators the dermal route of exposure is many times more significant than the respiratory route of exposure.

Table 1. DERMAL VERSUS RESPIRATORY EXPOSURE

Pesticide	Dermal ÷ Respiratory*	Method of Application	Reference
Parathion	470	Ground Boom	Wolfe, 1967
Paraquat	400	Ground Boom	Staiff, 1975
EPN	227	Ground Boom	Velsicol, 1979
EPN	180	Ground Boom	Atallah, 1982
DEF	560	Ground Boom	Wilson, 1980
Dicamba	747	Ground Boom	Street, 1982
2,4-D	869	Ground Boom	Street, 1982
2,4-D	50	Hand Gun	Libich, 1984
2,4,5-T	1000	Spray Tractor	Lavy, 1980
Fenthion	500	Air Blast	Wolfe, 1974
Amitraz	421	Air Blast	USDA, 1974
Captan	618	Air Blast	Deer, 1983

\*Dermal dose divided by respiratory dose. The column number means the dermal dose was that many times greater than the respiratory dose.

### DERMAL ABSORPTION

Dermal exposure is much greater than respiratory, but the dermally deposited pesticide is still outside of the body while the respiratory dose is inside the body. How much of the dermal exposure is absorbed into the body?

Table 2. DERMAL ABSORPTION OF PESTICIDES IN HUMANS

<u>Pesticide</u>	<u>Percent Dose Absorbed*</u>
Diquat	0.4
Ethion	3.3
2,4-D	5.8
Malathion	6.8
Dieldrin	7.7
Aldrin	7.8
Parathion	8.6
Lindane	9.3
Azodrin	14.7
DDT	15.0
Azinphos-Methyl (Guthion)	15.9
Propoxur (Baygon)	19.6
Carbaryl (Sevin)	73.9

\*Ventral forearm site of application of 4 microgram/cm<sup>2</sup> for 24-h exposure.

(Wester, 1984 and Maibach, 1974)

## ABSORPTION BY BODY AREA

At the April, 1984 meeting of the Division of Pesticide Chemistry of the American Chemical Society, Dr. Howard Maibach discussed the dermal absorption of pesticides. He stated that the scrotal, jaw, forehead, and scalp areas of the body absorb pesticides most rapidly. Damaged skin absorbs 3-10 times faster than normal skin. Contaminated covered skin also absorbs more. For malathion, bare skin absorbed 7% of the applied dose after 24 hours while contaminated covered skin absorbed 63%. Washing the skin 15 minutes after application reduced absorption for parathion from 8.6% to 5%, but washing skin 8 hours after application actually increased absorption to 15%.

Table 3. ABSORPTION OF INSECTICIDES BY BODY AREA

<u>Body Area</u>	<u>Percent Dose Absorbed*</u>		
	<u>Parathion</u>	<u>Malathion</u>	<u>Carbaryl</u>
Palm of Hand	11.8	5.8	--**
Back of Hand	21.0	12.5	--
Forearm	8.6	6.8	73.9
Elbow	28.4	--	--
Armpit	64.0	28.7	--
Jaw	33.9	--	69.9
Ear	40.3	--	--
Forehead	36.3	23.2	--
Scalp	32.2	--	--
Abdomen	18.5	9.4	--
Scrotum	101.6	--	--
Ball of Foot	13.5	6.8	--

\*Per 24-h exposure at concentration of 4 microgram/cm<sup>2</sup>.

\*\* -- means body area not tested

(Maibach, 1974)

Parathion and malathion are organophosphate insecticides. Carbaryl is a carbamate insecticide. Carbaryl appears to be absorbed more than either malathion or parathion. Parathion generally is absorbed twice as much as malathion.

## ABSORPTION BY CONTACT TIME

The longer the time that a pesticide remains in contact with the skin, the more will be absorbed. Table 4 illustrates this for malathion.

Table 4. EFFECT OF SKIN CONTACT TIME ON MALATHION ABSORPTION IN HUMANS

Duration (h)	Percent dose absorbed*
0	9.6
0.5	7.3
1	12.7
2	16.6
4	24.2
8	38.8
24	62.8

\* Per 24-h exposure at concentration of 4 microgram/cm<sup>2</sup>.

(Maibach, 1974)

## PRECAUTIONARY STATEMENT

All pesticides have both benefits and risks. Benefits can be maximized and risks minimized by reading and following the labeling. Pay close attention to the directions for use and the precautionary statements. The information on pesticide labels contains both instructions and limitations. Pesticide labels are legal documents and it is a violation of both federal and state laws to use a pesticide inconsistent with its labeling. The pesticide applicator is legally responsible for proper use. Always read and follow the label.

Howard Deer  
Extension Pesticide Specialist