

ESTIMATION OF EXPOSURE OF PERSONS IN  
CALIFORNIA TO PESTICIDE PRODUCTS THAT  
CONTAIN MALATHION AND ESTIMATION OF  
EFFECTIVENESS OF EXPOSURE REDUCTION MEASURES

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SUMMARY

Malathion's long history of use and low toxicity have made it the insecticide of choice in many vector control and pest eradication programs. This has led to repeated evaluations of its safety. Consideration in this report is restricted, consequently, to two worst case scenarios. It is concluded that the most extreme occupational exposure that occurs in the state under the most liberal interpretation of use instructions results in an absorbed dose of 1.0 mg/kg/day. The highest exposure to a home use product consistent with the most liberal interpretation of label directions is estimated at 0.52 mg/kg/day to a 10-kg child.

DESCRIPTIVE DATA

Malathion is a widely used organophosphate insecticide of low mammalian toxicity. Its low toxicity is attributed to detoxification by a mammalian liver enzyme sometimes referred to as aliesterase, which catalyses the hydrolysis of either of the two ethyl groups esterified to the succinate moiety. Aliesterase is inhibited by impurities sometimes found in carelessly prepared or stored malathion, especially iso-malathion, which increases the toxicity of the preparation.

Malathion is metabolized and excreted rapidly, and does not bio-accumulate.

As a consequence, the label signal word on almost all malathion products, even those containing over 90 percent of the active ingredient, is CAUTION. A few use WARNING and two use DANGER, but this appears to relate to other ingredients in a mixture.

Some malathion products contain cyclohexanone or methylene chloride; a number include large amounts of xylene and/or petroleum-derived solvents, (which may contain xylene), among their active ingredients. These will require regulatory action at a later date, because of concerns about the toxicity of xylene and so-called inert ingredients.

Of the 143 California registered products with labels present in the files, 79 are liquid concentrates, 20 are dilute liquid formulations, (less than 10 percent malathion), 31 are dusts, eight are wettable powders and five use wheat flour as a carrier. Of the eight product files not readily available for initial review, three are identified as dusts, one as wettable, three are "sprays" and the last is "Aqua Malathion 8". In all, nearly 4 million pounds of malathion were sold in California in 1985.

### USES

Malathion is employed for a great variety of uses. It is sprayed aerially or by tractor on orchards and field crops and is used in vector control, and insect pest eradication programs, which may involve spraying of populated areas. It is a component of seed treatments, and is used for post-harvest protection of fruits and grains. It is used to control parasites of livestock, fowl and household pets. It is available as a fog for greenhouses. It is sold for home use both indoors and outdoors, and is also used for indoor control of insects in commercial settings.

### ILLNESS REPORTS

Reports of illnesses in California attributed to accidental exposure to malathion are remarkable primarily for their variability. Workers spray themselves directly and report only localized rash, while people next door to an application complain of systemic effects. Among systemic symptoms reported, GI manifestations include nausea, cramps and diarrhea; but these complaints are not more common than headaches and dizziness.

### BEHAVIOR ON SKIN

Contact sensitization to malathion has been reported<sup>(1,2)</sup>, although apparently this is not common.

Based on biological monitoring of human exposure to malathion<sup>(3,4)</sup>, we are estimating dermal absorption of malathion to be 10 percent in 24 hours.

## HUMAN EXPOSURE

Malathion has been evaluated previously in connection with its use in pest eradication programs. The Departments of Food and Agriculture and Health Services jointly prepared an evaluation in 1980<sup>(5)</sup>, and the Department of Food and Agriculture has developed a risk characterization document relative to the current control efforts. The California Department of Public Health previously performed such studies in 1954<sup>(6)</sup> and 1956<sup>(7)</sup>. None of these investigations found any likelihood of danger to the public or to application personnel. Now we are engaged in re-evaluation of malathion pursuant to the requirements of SB 950. In light of the extensive reviews performed in the past, we will restrict our discussion of exposure to two worst-case scenarios, one agricultural and one related to home use.

Of the home use products, malathion formulations designed for residual protection of floors and other home surfaces have the greatest potential for high exposure. These generally involve combinations of malathion with other pesticides, such as diazinon or carbaryl, or petroleum-derived solvents. An example is an 8-oz aerosol can with instructions to "spray on", without indicating how much to spray. Another distributor provides a similar formula in 16-oz bottles, with instructions to spray until wet but not dripping. If the entire contents of the 8-oz can, which contains 0.7 percent malathion along with 0.3 percent diazinon, were applied to the floor of a room, it would provide 1588 mg malathion. Supposing a typical room might be 3.5 meters x 3.5 meters, (floor surface area of 12.25 m<sup>2</sup>), malathion would have an average density of 13 micrograms per square centimeter.

A worst case exposure scenario would involve a small child, weighing 10 kg and having 4000 square centimeters of skin surface, playing on a smooth floor treated with a whole can of malathion. Under those conditions, the malathion on the floor might distribute evenly onto the child's skin, reaching the same concentration as on the floor, that is, 13 micrograms per square centimeter, or a total of 52 milligrams. Assuming dermal absorption of 10 percent in 24 hours, the child's absorbed dose would be 5.2 mg, or 0.52 mg/kg. Children are not expected to spend more than 18 months of their lives crawling on the floor<sup>(8)</sup>.

The most intensive agricultural use of malathion identified in California is dusting of dates, in which five percent malathion dust is blown upwards into the trees at rates up to 85 lbs (4.25 lbs of active ingredient) per acre. This procedure was therefore studied<sup>(9)</sup> using hand washings, air sampling and dermal patches, (gauze pads attached at various locations on the workers' clothing and analyzed for accumulated malathion). It is apparent that inhalation exposure is no more than 5 mg per eight-hour day. Recovery from the hands ranged from 0.4 mg to 36 mg. The average was about 4.5 milligrams. Dermal pad accumulation ranged from less than 1 microgram per square centimeter to over 80 micrograms per square centimeter. The highest total exposure for a worker, assuming 90 percent protection by clothing, was 152 milligrams. This worker was monitored for less than a full workday. Other workers who were monitored all day accumulated less malathion, and this figure may represent a saturation condition. Still, this will be normalized to an eight-hour work day by strict proportionality, giving 463 mg malathion. Including the most extreme amounts found on the hands, the workers may be exposed to as much as 499 mg malathion dermally.

If dermal absorption is 10 percent and inhalation absorption is 100 percent, these workers are receiving doses of no more than 55 mg/day, or 1.0 mg/kg/day for a woman weighing 54.8 kg. Such work may be performed as many as 100 days<sup>(10)</sup> each year.

Re-entry to fields treated with malathion was considered by Pependorf in his recent review<sup>(11)</sup> of data relating to re-entry. He concluded that the low toxicity of malathion justified no reentry interval.

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