

## 5. PRODUCTION, IMPORT/EXPORT, USE, AND DISPOSAL

### 5.1 PRODUCTION

The organophosphorus insecticide, S-1,2-di(ethoxycarbonyl)ethyl *O,O*-dimethyl phosphorodithioate (common chemical name: malathion), is commercially produced in the United States and abroad.

Malathion is not known to occur as a natural substance (IARC 1983). It is produced commercially by the reaction of phosphorus pentasulfide ( $P_2S_5$ ) with methanol in toluene solvent to produce an intermediate, dimethylphosphorodithioic acid (DMPDT), and a byproduct, hydrogen sulfide ( $H_2S$ ) (Sittig 1980). The DMPDT intermediate is isolated and then reacted with either diethylfumarate or diethylmaleate. The crude material is then stripped of solvent, washed, and filtered to produce technical-grade malathion.

Malathion was first commercially produced in the United States in 1950 by American Cyanamid Chemical Company (USTC 1953) and was first registered in the United States in 1956. Manufacturing rights were transferred to Cheminova Agro, Inc. in 1991 (EPA 1999). Production volume data were not located for the 1950s and 1960s. The production of malathion was estimated to be 24 million pounds in 1972 (Santodonato 1985; von Rumker et al. 1974) and 30 million pounds in 1978 (IARC 1983). No recent production volume data are available for malathion.

As of 1999, there were 63 pesticide formulators of malathion for the United States markets. The 63 formulators produce approximately 235 products that contain malathion. Some of the products contain other active ingredients, such as methoxychlor (EPA 1999). Table 5-1 lists the production year, number of facilities, the state where each facility is located, and the range (in pounds) for each domestic manufacturer that reported the production or formulation of malathion in 2000 (TRI00 2002).

Manufacturers are required to report Toxics Release Inventory (TRI) data to satisfy EPA requirements. The TRI data should be used with caution since only certain types of facilities are required to report. This is not an exhaustive list.

### 5.2 IMPORT/EXPORT

Data for import for 1977 and export volumes of malathion are limited. Import volumes reported were 6,457 pounds for light (USITC 1978) and 143,260 pounds for 1982 (SRI 2000); no recent import volume

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**Table 5-1. Facilities that Produce, Process, or Use Malathion**

| State <sup>a</sup> | Number of facilities | Minimum amount on site in pounds <sup>b</sup> | Maximum amount on site in pounds <sup>b</sup> | Activities and uses <sup>c</sup> |
|--------------------|----------------------|---|---|----------------------------------|
| AR                 | 1                    | 10,000  | 99,999  | 12                               |
| GA                 | 3                    | 100,000                                       | 999,999                                       | 2, 3, 4, 7, 9                    |
| IA                 | 1                    | 10,000  | 99,999  | 7                                |
| MO                 | 2                    | 100,000                                       | 99,999,999                                    | 7, 9                             |
| MS                 | 1                    | 100,000                                       | 999,999                                       | 7                                |
| TX                 | 3                    | 10,000  | 999,999                                       | 9, 12                            |

Source: TRI00 2002

<sup>a</sup>Post office state abbreviations used

<sup>b</sup>Amounts on site reported by facilities in each state

<sup>c</sup>Activities/Uses:

- |                          |                          |                             |
|--------------------------|--------------------------|-----------------------------|
| 1. Produce               | 6. Impurity              | 11. Chemical Processing Aid |
| 2. Import                | 7. Reactant              | 12. Manufacturing Aid       |
| 3. Onsite use/processing | 8. Formulation Component | 13. Ancillary/Other Uses    |
| 4. Sale/Distribution     | 9. Article Component     | 14. Process Impurity        |
| 5. Byproduct             | 10. Repackaging          |                             |

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data are available. In 1978, U.S. exports of malathion were estimated to be 11,020,000 million pounds (SRI 2000).

### 5.3 USE

Malathion is a nonsystemic broad-spectrum organophosphorus (OP) contact, stomach, and respiratory insecticide and acaricide effective by direct contact, oral ingestion, and inhalation exposure that is used in agriculture and horticulture applications (HSDB 2001). Malathion is applied to a wide variety of crops including alfalfa, apple, apricot, asparagus, avocado, barley, bean (succulent and dry), beets (garden, table, and sugar), blackberry, blueberry, boysenberry, broccoli, cabbage, carrot, cauliflower, celery, chayote, cherry, clover, corn, cotton, cucumber, date dewberry, eggplant, potato, fig, flax, garlic, gooseberry, grape, grapefruit, guava, hay grass, hops, horseradish, kale, kohlrabi, kumquat, leek, lemon, lettuce, lime, loganberry, macadamia nut, mango, melon, mint, mushroom, mustard greens, nectarines, oats, okra, onion, orange, pea, peach, pear, pecan, pepper, pineapple, pumpkin, radish, raspberry, spinach, wheat, squash, strawberry, tangerine, tomato, walnut, watermelon, wild rice, and yam crops. Malathion may also be used for an indoor stored commodity treatment and in empty storage facilities for barley, corn, oats, and wheat (EPA 2000d). It is also used by homeowners for ornamental flowering plants, ornamental lawns, ornamental turf, vegetable gardens, and fruit trees; at golf courses for ornamental flowers, shrubs, and trees; at Christmas tree plantations; and around uncultivated nonagricultural areas, outdoor garbage dumps, intermittently flooded areas, irrigation and sewage systems, pastures, and range land. Malathion is also used to control ectoparasites of cattle (Budavari 1996), flies, and human head and body lice (nonFIFRA pharmaceutical use). It is also used in regional pest eradication programs to control boll weevil, medfly (USDA), and mosquito (EPA 2000d). Malathion is generally applied as a spray using conventional ground or air equipment, and application rates depend on use (von Rumker et al. 1974).

Data for the domestic use of malathion by volume was estimated to be 16.2 million pounds in 1972, and 2–3 million pounds in 1995 and 1996 (EPA 2000e). The estimated total average use of malathion in the United States is 16.7 million pounds as the active ingredient. Of the 16.7 million pounds, approximately 12 million pounds of active ingredient are used on agricultural crops and 90% of the 12 million pounds is used on cotton to control boll weevil (USDA); approximately 0.5 million pounds are used around buildings, roads, and ditches; approximately 0.3 million pounds are applied to post harvest corn, wheat, and oats; approximately 800,000 pounds are used for medfly control (USDA); and approximately 472,000 pounds are used to control mosquitos (EPA 2000d). Other sources state that the total amount of

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malathion used in 1994 in the United States was 3,377,681 pounds (Gianessi and Anderson 1997), with 782,434 pounds in California (Annual Pesticide Use Report 1996)

**5.4 DISPOSAL**

Incineration in a furnace equipped with an afterburner and a scrubber is the recommended method of disposal for malathion (Sittig 1985). If incineration is not an available option, malathion may be disposed of by absorbing in vermiculite, dry sand, earth, or a similar material and then being buried at a designated landfill site (Mackison 1981). Only small amounts of malathion may be land filled (United Nations 1985). Waste water treatment technologies using biological treatment and reverse osmosis have been investigated for malathion (EPA 1982).

Another method of disposal that has been suggested for malathion is molten salt combustion using potassium chloride. This process is attractive because the destruction of malathion is >99% and the products of combustion can be used as a fertilizer (United Nations 1985).