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OFFICE OF
CHEMICAL SAFETY AND
POLLUTION PREVENTION

**DATE:** June 9, 2016

**SUBJECT:** **Malathion:** Human Health Draft Risk Assessment for Registration Review

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| **PC Code:** 057701 | **DP Barcode:** D414107 |
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| **TXR No.:** NA | **CAS No.:** 121-75-5 |
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This document provides the HED's human health risk assessment for the Registration Review of malathion (*O,O*-dimethyl dithiophosphate of diethyl mercaptosuccinate). The hazard characterization and endpoint selection were provided by Yung Yang; the residue chemistry assessment was provided by Mohsen Sahafeyan; the dietary exposure assessments were provided by Sheila Piper; the occupational and residential exposure assessment and risk assessment were provided by Shalu Shelat; and the drinking water assessment was provided by Andrew Shelby of the Environmental Fate and Effects Division (EFED).

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## 1.0 Executive Summary

Malathion is a non-systemic, wide spectrum organophosphorus (OP) insecticide. It is used in the agricultural production of a wide variety of food/feed crops to control insects such as aphids, leafhoppers, and Japanese beetles. Malathion is also used in the Cotton Boll Weevil Eradication Program, Fruit Fly (Medfly) Control Program, and for mosquito-borne disease control. It is also available to the home gardener for outdoor residential uses which include vegetable gardens, home orchards, and ornamentals. Malathion is formulated as a technical, a dust, an emulsifiable concentrate (EC), a ready-to-use (RTU) product, a pressurized liquid, and a wettable powder (WP). Several of the 95% liquids are intended for ultra-low-volume (ULV) applications. Malathion can be applied using ground or aerial equipment, thermal and non-thermal fogger, ground boom, airblast sprayer, chemigation, and a variety of hand-held equipment such as backpack sprayers, low pressure handwands, hose-end sprayers, and power dusters. Permanent tolerances have been established in 40 CFR §180.111 for the total residues of the insecticide malathion (*O,O*-dimethyl dithiophosphate of diethyl mercaptosuccinate ) including its oxygen analog in/on various plants and livestock commodities.

Like other OPs, the initiating event in the adverse outcome pathway (AOP)/ mode of action (MOA), for malathion involves inhibition of the enzyme acetylcholinesterase (AChE) via phosphorylation of the serine residue at the active site of the enzyme. This inhibition leads to accumulation of acetylcholine and ultimately to neurotoxicity in the central and/or peripheral nervous system. Malathion requires metabolic activation to an oxon to inhibit AChE. OPs also exhibit a phenomenon known as steady-state AChE inhibition (AChEI). After repeated dosing at the same dose level, the degree of inhibition comes into equilibrium with the production of new, uninhibited enzyme. Therefore, steady-state exposure assessments (21 days and longer) were conducted instead of the typical chronic duration dietary assessment.

The toxicology database for malathion is complete for risk assessment. Malathion has high quality dose response data across multiple lifestages, durations, and routes for both red blood cell (RBC) and brain AChEI. RBC AChEI was more sensitive than brain AChEI in all species and there is no sex difference. Accordingly, RBC AChEI is the critical endpoint for oral and dermal risk assessments. However, for inhalation exposure, histopathological lesions of the nasal cavity and larynx were observed at a dose lower than the dose causing AChEI. Therefore, the point of departure (POD) based on histopathological lesions of portal-of-entry effects was selected for inhalation risk assessment. Clinical signs of neurotoxicity (such as, tremors, salivation, urogenital staining, and decreased motor activity) were seen throughout the database of experimental toxicity studies at doses higher (10-fold) than those causing AChEI.

Rat and rabbit developmental toxicity studies revealed no evidence of quantitative and/or qualitative susceptibility; developmental effects were seen in the presence of comparable maternal toxicity. In the rat reproduction study, decreased pup body weights were observed during lactation period in the $F_{1a}$ and $F_{2b}$ pups in the absence of maternal toxicity indicating quantitative susceptibility. In the developmental neurotoxicity study, several clinical signs and changes to brain morphometrics were noted in offspring in the presence of limited maternal toxicity (increased salivation), indicating qualitative susceptibility. Although AChE activity was not measured in the developmental and reproduction studies, the POD used for risk assessment, based on AChEI, are protective of the susceptibility seen in these studies. In the acute and repeated dose comparative cholinesterase assay (CCA) studies, fetal animals were not more

sensitive than pregnant animals to AChEI and pregnant animals were comparable to non-pregnant animals. The CCA studies demonstrate that PND 11 pups are more sensitive than adults to AChEI. For OPs, there is also uncertainty in the human dose-response relationship for neurodevelopmental effects.

Malathion is classified as "suggestive evidence of carcinogenicity but not sufficient to assess human carcinogenic potential" by all routes of exposure.

Malathion exhibits low toxicity in acute lethality studies via the oral, dermal, or inhalation route (Toxicity Category III or IV). It exhibits only slight eye and dermal irritation and is not a dermal sensitizer. There is no convincing evidence for potential interaction with the estrogen, androgen or thyroid pathway.

Malathion is metabolized to its oxon (malaoxon) in both insects and mammals and in the environment through photo-oxidation. The oxon is the active AChE inhibiting metabolite of malathion and is more potent than the parent. In order to account for the increased toxicity from exposure to malaoxon, a toxicity adjustment factor (TAF) was calculated from CCA studies to be 22X, which means that malaoxon is estimated to be 22 times more toxic than malathion. This TAF was applied to residues of malaoxon for risk assessment of all exposure durations, routes, and scenarios.

For oral and dermal exposure scenarios, the PODs are based on the most sensitive effect, RBC AChEI. However, for inhalation exposure scenario, the POD is based on portal of entry effects, which were observed at a dose lower than the dose causing AChEI. For oral and dermal exposures, an uncertainty factor (UF) of 1000X (10X for interspecies extrapolation, 10X for intraspecies variation and 10X for FQPA SF) is applied to population subgroups that include infants, children, youth and women of childbearing age; the FQPA SF of 10X is retained to account for uncertainty in knowing whether neurodevelopmental effects occur at doses lower than OP effects. An UF of 100X is applied to the population subgroup of adults 50-99 years old for which the FQPA SF is not retained. For inhalation exposure, a total UF of 3000X (3X for interspecies extrapolation, 10X for intraspecies variation, 10X for FQPA SF, and 10X for LOAEL to NOAEL extrapolation) is applied for all inhalation exposure scenarios; the standard interspecies extrapolation uncertainty factor was reduced from 10X to 3X due to the human equivalent concentration (HEC) calculation accounting for pharmacokinetic (not pharmacodynamic) interspecies differences, and an additional 10X was applied for LOAEL to NOAEL extrapolation.

The existing residue chemistry database for malathion is adequate for risk assessment purposes. The residues of concern for both tolerance expression and risk assessment include malathion and malaoxon. The acute and steady state dietary exposure assessment incorporated the latest USDA Pesticide Data Program (PDP) monitoring data for malathion and its metabolite (malaoxon), field trial data (when monitoring data were unavailable), empirical and default DEEM processing factors, percent crop treated (PCT) estimates and a TAF of 22X for the oxon was applied to food and drinking water. Malathion has also been used in public health mosquito control, and an adulticide use was included in the dietary exposure assessment. While the registrant has petitioned for tolerances based on the adulticide use for those crops without registered agricultural uses, these tolerances have not been formally established.

The Environmental Fate and Effects Division (EFED) provided daily time series outputs of malathion in drinking water for six different application scenarios. The WA cherry maximum aerial scenario results in the highest estimated drinking water concentration. Malathion dietary exposure for food alone is 27% of the acute population adjusted dose (aPAD) for the U.S. population, and children 1-2 years old, the most highly exposed population subgroup, is 74% of the aPAD at the 99.9$^{th}$ percentile. Combined dietary exposure from food and drinking water is 240% of the aPAD for the U.S. population and 690% of the aPAD for all infants (<1 year old), the highest exposed population subgroup.

The food only steady state exposure and estimated risk values are below HED's level of concern; the U.S. population is 24% of the steady state population adjusted dose (ssPAD) and 48% of the ssPAD for children 1-2 years old, the most highly exposed population subgroup. Combined dietary exposure from food and drinking water is 170% of the ssPAD for the U.S. population and 470% of the ssPAD all infants (<1 year old), the most highly exposed population subgroup. Further characterization and refinement of drinking water exposure is being considered while taking into account types and magnitudes of exceedances demonstrated in the dietary assessment. These additional characterizations and refinements may include use of typical rates, application timing with respect to individual run-off events, spatial distribution of usage footprint, and sensitivity to scenario curve number.

The existing exposure database for malathion is adequate for risk assessment purposes. Residential adult handler dermal and inhalation exposure and risk estimates were calculated for the registered uses of malathion. In general, dermal risk estimates ranged from 17 to 3100 (LOC = 1,000) and inhalation risk estimates ranged from 48 to 2,000,000 (LOC = 3,000). The residential handler inhalation exposure and risk estimates indicate that MOEs are not of concern to HED (i.e., MOE $\geq$ 3000) for most scenarios with the exception of the following scenarios: manually-pressurized handwand application to outdoor perimeter areas of households (MOE = 1,900); hose-end sprayer application to standing water/mosquito areas (MOE = 1,500), backpack application for outdoor building perimeter and mosquitos (MOE = 250 and 720), and for mosquito control misting/fogger applications (MOEs = 240 and 48). Dermal exposure and risk estimates, however, are of concern (i.e., MOEs < 1000) for most scenarios.

Residential post-application dermal exposure and risk estimates were assessed for all residential uses for malathion as well as for the pick–your-own scenario. Additionally, residential post-application dermal and inhalation exposure was assessed for exposures following public health mosquitocide/adulticide applications with malathion. All dermal exposure and risk estimates for adults and children (1 to <2 years old and 6 to <11 years old) were of concern to HED (MOEs < 1000) for the aerial mosquitocide applications, residential garden uses, and pick-your-own scenarios ranging from MOEs of 55 to 340. Inhalation exposure from the aerial mosquitocide applications were also of concern to HED (MOE of 700, LOC = 3000) for adults and children. The dermal, incidental oral, and inhalation post-application exposures and risk estimates from the ground-based mosquitocide ULV applications were not of concern to HED (dermal MOEs $\geq$ 1000 and inhalation MOEs $\geq$ 3000).

A quantitative non-occupational spray drift assessment was conducted for the registered uses of malathion. The assessment considers both malathion residues and residues of the major metabolite, malaoxon. Adult dermal and children's (1 to < 2 year old) dermal and incidental oral risk estimates from indirect exposure related to spray drift result in MOEs < 1000 at the edge of

the field for many scenarios and a range of buffers depending on the spray drift scenario (e.g., no buffers to buffers >300 feet). Results indicate that the major spray drift risk concern is from aerial applications, however, groundboom and airblast scenarios also result in risks of concern for many of the registered application rates.

Volatilization of pesticides may be a source of post-application inhalation exposure to individuals nearby pesticide applications. The Agency has developed a Volatilization Screening Tool and a subsequent Volatilization Screening Analysis to be conducted during Registration Review. Because malathion and malaoxon have also been detected in multiple ambient air studies, the Agency has developed a preliminary bystander volatilization exposure assessment. Based on the currently available inhalation toxicity and air monitoring data, the analysis resulted in no risks of concern (MOEs $\geq$ 3,000) with the exception of one application based monitoring study for which the residential bystander MOEs = 1,000.

The acute aggregate risk assessment combines exposures to malathion and malaoxon from food and drinking water only. There are acute aggregate risk estimates of concern. The steady state aggregate assessment includes the steady state dietary (food and water) and residential exposures. There are steady state aggregate risks of concern. However, because there are risks of concern associated with dietary and residential exposure individually, a quantitative steady state aggregate risk assessment was not conducted.

Occupational handler dermal and inhalation exposure and risk estimates were calculated for the registered uses of malathion. The occupational handler exposure and risk estimates indicate that the steady-state dermal and short-/intermediate-term inhalation MOEs are of concern to HED (i.e., MOE $\leq$ 1000 and 3000) for many scenarios, assuming the use of label-required clothing and personal protective equipment (PPE). In general, MOEs for mixing/loading for all application types and applying via handheld and airblast equipment, resulted in MOEs of concern at most application rates.

Occupational post-application dermal exposure and risk estimates were assessed for all registered uses of malathion using submitted chemical-specific dislodgeable foliar residue (DFR) data. The post-application assessment considers both malathion residues and residues of the major metabolite, malaoxon. Current product-label REIs range from 12 to 24 hours depending on the crop. These REIs are in line with the 40 CFR 156.208 (c) (2) assignments for active ingredients that are classified as Toxicity Category III and IV for acute dermal, eye irritation, and primary skin irritation. However, based on the current exposure assessment, post-application risk estimates remain of concern in some situations up to 9 days with one scenario as high as 13 days after application (i.e., dermal MOEs < 1000).

Based on the Agency's current practices, a quantitative non-cancer occupational post-application inhalation exposure assessment was not performed for malathion at this time. If new policies or procedures are put into place, the Agency may revisit the need for a quantitative occupational post-application inhalation exposure assessment for malathion.

This risk assessment relies in part on data from studies in which adult human subjects were intentionally exposed to a pesticide or other chemical. These data, which include studies from Pesticide Handler Exposure Database (PHED) 1.1, Outdoor Residential Exposure Task Force (ORETF), the Agricultural Handlers Exposure Task Force (AHETF) database, and the

Agricultural Reentry Task Force (ARTF) database are (1) subject to ethics review pursuant to 40 CFR 26, (2) have received that review, and (3) are compliant with applicable ethics requirements. For certain studies, the ethics review may have included review by the Human Studies Review Board. Descriptions of data sources, as well as guidance on their use, can be found at the Agency website[1].

## 2.0 HED Recommendations

### 2.1 Data Deficiencies

None.

### 2.2 Tolerance Considerations

#### 2.2.1 Enforcement Analytical Method

*Plant Commodities:* Malathion is adequately recovered using a GLC method with flame photometric detection (FPD) operating in the phosphorus mode for enforcement purposes. Method-1866 determines residues of malathion and malaoxon in/on plant commodities and has a limit of quantitation (LOQ) of 0.05 ppm for each compound. The method has undergone a successful independent laboratory validation, and acceptable radiovalidation data have also been submitted and evaluated. Samples of raw agricultural and processed commodities from recent field trials and processing studies were analyzed by Method-1866 or its modifications.

Presently, the Pesticide Analytical Manual (PAM) Volume II lists a TLC method, a GLC method with KCl thermionic detection, and a spectrophotometric method as Methods I, II, and III, respectively, for the enforcement of malathion tolerances (expressed as malathion *per se*) in/on plant commodities.

*Livestock commodities*: No analytical enforcement method for residues in livestock tissues is required as residues of malathion in livestock commodities represent a Category 3 situation under 40 CFR §180.6(a), i.e., there is no reasonable expectation of malathion residues being transferred from treated feed items to livestock commodities. The current tolerances on livestock commodities should be removed.

[1] http://www.epa.gov/pesticides/science/handler-exposure-data.html and http://www.epa.gov/pesticides/science/post-app-exposure-data.html

*Multiresidue Methods:* The reregistration requirements for multiresidue method testing for residues of malathion and malaoxon are satisfied. The 2/97 FDA PESTDATA database (PAM Volume I, Appendix I) indicates that malathion is completely recovered (>80%) using multiresidue methods PAM Volume I Sections 302 (Luke method; Protocol D), 303 (Mills, Onley, and Gaither method; Protocol E), and 304 (Mills method for fatty food). Malaoxon is completely recovered (>80%) using multiresidue method PAM Volume I Sections 302 (Luke method; Protocol D) but is not recovered using method Sections 303 (Mills, Onley, and Gaither method; Protocol E), and 304 (Mills method for fatty food). I) indicates that malathion is completely recovered (>80%) using multiresidue methods PAM Volume I Sections 302 (Luke method; Protocol D), 303 (Mills, Onley, and Gaither method; Protocol E), and 304 (Mills method for fatty food). Malaoxon is completely recovered (>80%) using multiresidue method PAM Volume I Sections 302 (Luke method; Protocol D) but is not recovered using method Sections 303 (Mills, Onley, and Gaither method; Protocol E), and 304 (Mills method for fatty food). I) indicates that malathion is completely recovered (>80%) using multiresidue methods PAM Volume I Sections 302 (Luke method; Protocol D), 303 (Mills, Onley, and Gaither method; Protocol E), and 304 (Mills method for fatty food). Malaoxon is completely recovered (>80%) using multiresidue method PAM Volume I Sections 302 (Luke method; Protocol D) but is not recovered using method Sections 303 (Mills, Onley, and Gaither method; Protocol E), and 304 (Mills method for fatty food).

### 2.2.2 International Harmonization

The Codex Alimentarius Commission has established several maximum residue limits (MRLs) for residues of malathion in/on various raw agricultural and processed commodities. The Codex MRLs are expressed in terms of malathion *per se*. The Codex MRLs and the U.S. tolerances will be incompatible when the U.S. tolerance expression for plant commodities is revised to include both residues of malathion and the metabolite, malaoxon. For a list of US tolerances and international residue levels see Appendix A.

### 2.2.3 Recommended Tolerances

The RED document (1999 and revised one in May 2009) cited some data deficiencies on pre- and post-harvest wheat, sorghum (forage and hay only) and cotton gin-byproduct, and Data Call Ins (DCIs) were issued. In response to those deficiencies, the registrant, Cheminova, submitted relevant studies. Those studies were reviewed after the 2009 RED was issued and satisfied the DCIs. As a result of those reviews, HED re-evaluated the current tolerances for some of the registered raw agricultural commodities (RACs) and recommended for amendment of existing tolerances or new tolerances on some feed items; for the purpose of registration review, those tolerances are shown in Table 2.2.3 below. HED notes that the tolerances listed in Table 2.2.3 below, are subject to safety findings in order to be established. In addition, the need for these, and whether these tolerances can be issued, will be reevaluated once the Organophosphate Cumulative Risk Assessment is revised. The recommended tolerances on feed items in Table 2.2.3 do not impact the tolerance status for livestock tissues.

**Table 2.2.3. Tolerance Summary for Malathion**

| Commodity | Established/Proposed Tolerance (ppm) | Recommended Tolerance (ppm) | Comments *Correct Commodity Definition* |
|---|---|---|---|
| Barley, hay[1] | -- | 30 | |
| Cotton, gin byproduct | --- | 2000 | |

**Table 2.2.3. Tolerance Summary for Malathion**

| Commodity | Established/Proposed Tolerance (ppm) | Recommended Tolerance (ppm) | Comments *Correct Commodity Definition* |
|---|---|---|---|
| Oat, hay[1] | --- | 30 | |
| Sorghum, forage | 8 | 40 | |
| Sorghum, stover | --- | 40 | |
| Wheat, hay[2] | ---- | 30 | |
| Wheat, grain | 8 | 15 | |
| Aspirated grain fractions[3] | --- | 2700 | |

[1]Barley and oat hay tolerances are translated from wheat hay as mentioned in 2009 RED.
[2]Recommended tolerance is for wheat hay resulting from either a SU formulation in ULV applications using aerial equipment with total rate not exceeding 2.25 lb ai/A (in 3 applications) and PHI of not less than 6 days or from an EC formulation using ground equipment with total rate not exceeding 4.39 lb ai/A (in 3 applications) and PHI of not less than 6 days.
[3] The recommended tolerance of 2700 ppm for aspirate grain fractions (AGF) is based on combined maximum residues of malathion and malaoxon (2691 ppm) in post-harvest wheat treatment (Piper, S., DP#292680, 3/12/09).

Furthermore, in the post 2009 RED, the Agency was petitioned for tolerances on all unregistered crops to cover residues from malathion public health (mosquito adulticide) uses as there is a need to cover some rural areas for mosquito control. HED considered this request and recommended a tolerance of 1.0 ppm on all unregistered crops from malathion mosquito adulticide uses (M. Sahafeyan, D420237, 06/07/2016). At such time as the Agency is able to make a safety finding, this tolerance should appear under 40 CFR, §180.111 (a) as:

> A tolerance of 1.0 ppm is established for residues of the insecticide malathion, including its metabolites and degradates, in or on all raw agricultural commodities, except those otherwise listed in this section, from use of the pesticide for area pest (mosquito and fly) control. Compliance with the tolerance levels specified is to be determined by measuring only the sum of malathion (*O,O*-dimethyl dithiophosphate of diethyl mercaptosuccinate) and its metabolite, malaoxon (O,O-dimethyl thiophosphate of diethyl mercaptosuccinate), calculated as the stoichiometric equivalent of malathion, in or on the commodity.

The tolerance expression for malathion [40 CFR §180.111] has also been reviewed and should be updated as follows based on HED's Interim Guidance on Tolerance Expressions (S. Knizner, 27-MAY-2009).

> Tolerances are established for residues of the insecticide, malathion including its metabolites and degradates, in or on the following food commodities. Compliance with the tolerance levels specified below is to be determined by measuring only the sum of malathion (*O,O*-dimethyl dithiophosphate of diethyl mercaptosuccinate) and its metabolite, malaoxon (O,O-dimethyl thiophosphate of diethyl mercaptosuccinate), calculated as the stoichiometric equivalent of malathion, in or on the following commodities.

## 2.3 Label Recommendations

### 2.3.1 Recommendations from Residue Reviews

HED further recommends that the following language be included on any malathion labels that have adulticide (public health) use:

Use in agricultural areas must be in a manner as to ensure that residues do not exceed the established federal tolerance for the active ingredient in or on raw agricultural commodities resulting from use for wide area pest control.

### 2.3.2 Recommendations from Occupational Assessment

Exposure and risk estimates of concern have been identified for occupational handlers. Additionally, post-application exposure and risk estimates have shown that current REIs may not be adequate for many post-application activities.

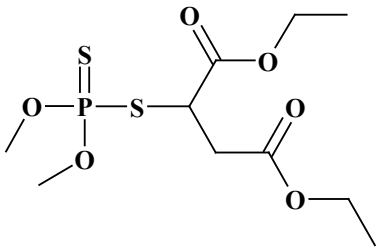
### 2.3.3 Recommendations from Residential Assessment

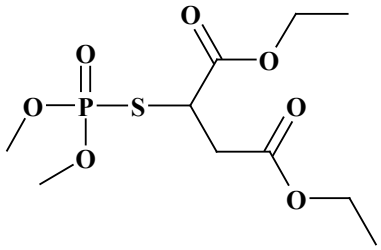
Exposure and risk estimates of concern have been identified for both residential handlers and post-application scenarios. Some of the registered malathion product labels with residential use sites (e.g., home ornamental and vegetable gardens as well as spot and perimeter outdoor uses for insect and mosquito control) require that handlers wear specific clothing (e.g., long sleeve shirt/long pants) and/or use personal protective equipment (PPE). Therefore, HED has made the assumption that these products are not for homeowner use, and has not conducted a quantitative residential handler assessment. The labels that were identified by the registrant to be homeowner uses but were reviewed to show PPE are as follows: EPA Reg Nos 45385-43; 47000-107; 28293-123; 33955-394; 4-412; 10088-56.

## 3.0 Introduction

## 3.1 Chemical Identity

**TABLE 3.1. Malathion and Malaoxon Nomenclature.**

| Compound | Chemical Structure |
|---|---|
| |  |
| Common name | Malathion |
| IUPAC name | Diethyl (dimethoxythiophosphorylthio)succinate |
| CAS name | O,O-dimethyl phosphorodithioate of diethyl mercaptosuccinate |
| CAS # | 121-75-5 |
| End-use product/(EP) | Technical (91-95% ai), dust (1-10% ai), emulsifiable concentrate (3-82% ai), ready-to-use (1.5-95% ai), pressurized liquid (0.5-3% ai), and wettable powder (6-50% ai) |
| | |

| TABLE 3.1. Malathion and Malaoxon Nomenclature. | |
|---|---|
| |  |
| Common name | Malaoxon |
| IUPAC name | 2-(dimethoxyphosphorylthio)butanedioic acid diethyl ester |
| CAS name | O,O-dimethyl thiophosphate of diethyl mercaptosuccinate |
| CAS # | 1634-78-2 |
| End-use product/(EP) | Not Registered |

## 3.2 Physical/Chemical Characteristics

Malathion is a colorless (pure form) to deep brown to yellow liquid with a mercaptan odor and a boiling point of 156-157ºC. Malathion is soluble in water and readily soluble in most alcohols, esters, and is only slightly soluble in aliphatic hydrocarbons. It has a log octanol-water partition coefficient of 2.36. Malathion residues, in general, are soluble and do not adsorb strongly to soils. It has a vapor pressure of 4.0 x 10-5 mm Hg. A table of physical/chemical properties for malathion can be found in Appendix B.

## 3.3 Pesticide Use Pattern

Malathion is a non-systemic, wide spectrum OP insecticide. It is used in the agricultural production of a wide variety of food/feed crops to control insects such as aphids, leafhoppers, and Japanese beetles. Malathion is also used in the cotton boll weevil and mormon cricket eradication programs and as a general wide-area treatment for mosquito-borne disease control (adulticide). It is also available to the home gardener for outdoor residential uses which include vegetable gardens, home orchards, various ornamentals and lawns as well as outdoor mosquito and insect control. The Agency has been informed by the basic producer (Cheminova A/S letters dated March 10, 1998 and March 18, 2002) that certain formulations and use sites will not be supported for reregistration and these uses are cancelled.

Malathion is formulated as a technical (91-95% ai), a dust (1-10% ai), an emulsifiable concentrate (3-82% ai), a ready-to-use (1.5-95% ai), a pressurized liquid (0.5-3% ai), and a wettable powder (6-50% ai). Several of the 95% liquids are intended for ULV applications. Malathion can be applied using ground or aerial equipment, thermal and non-thermal fogger, ground boom, airblast sprayer, chemigation, and a variety of hand-held equipment such as backpack sprayers, low pressure handwands, hose-end sprayers, and power dusters. For most use sites/crops, the maximum application rates range from 0.18 lb ai/A to 10 lbs ai/A with the exception of cull pile applications which are registered for 299 lbs ai/A.

Most of the malathion registered labels require single layer of clothing in addition to some PPE. Occupational handlers are required to wear a single layer of clothing (long-sleeved shirt and long pants), shoes plus socks, protective eyewear (either goggles or face shield), chemical-resistant apron, chemical-resistant headgear, and chemical-resistant gloves. Only one label (EPA Reg No.

1015-69), requires the use of coveralls and a NIOSH approved respirator with any N, R, P, or HE filter. This end-use product is the only registered dust formulation for malathion. Depending on the crop, the registered labels for malathion recommend a range of restricted entry intervals (REIs) from 12 hours to 24 hours.

A full description of the use pattern for malathion is provided in Appendix C.

### 3.4 Anticipated Exposure Pathways

Humans may be exposed to malathion, and its metabolite malaoxon, in food and drinking water, since malathion may be applied directly to growing crops and application may result in malathion reaching sources of drinking water. There are also residential uses of malathion; therefore, there is the potential for short-term inhalation and steady state non-occupational exposure (dermal and incidental oral) to malathion and malaoxon as a result of registered uses. There is also the potential for non-occupational bystander dermal and incidental oral exposures as a result of spray drift. Due to the potential for environmental transformation of malathion to malaoxon, the handler scenarios consider exposure to the parent, malathion only, and post-application scenarios consider exposure to the parent and the malaoxon metabolite.

Based on the registered use pattern for malathion, short- and intermediate-term inhalation and steady state dermal exposures are anticipated for occupational handlers and post-application workers.

### 3.5 Consideration of Environmental Justice

Potential areas of environmental justice concerns, to the extent possible, were considered in this human health risk assessment, in accordance with U.S. Executive Order 12898, "Federal Actions to Address Environmental Justice in Minority Populations and Low-Income Populations," (http://www.eh.doe.gov/oepa/guidance/justice/eo12898.pdf). As a part of every pesticide risk assessment, OPP considers a large variety of consumer subgroups according to well-established procedures. In line with OPP policy, HED estimates risks to population subgroups from pesticide exposures that are based on patterns of that subgroup's food and water consumption, and activities in and around the home that involve pesticide use in a residential setting. Extensive data on food consumption patterns are compiled from the U.S. Department of Agriculture's National Health and Nutrition Examination Survey, What We Eat in America, (NHANES/WWEIA) and are used in pesticide risk assessments for all registered food uses of a pesticide. These data are analyzed and categorized by subgroups based on age, season of the year, ethnic group, and region of the country. Additionally, OPP is able to assess dietary exposure to smaller, specialized subgroups and exposure assessments are performed when conditions or circumstances warrant. Whenever appropriate, non-dietary exposures based on home use of pesticide products and associated risks for adult applicators and for toddlers, youths, and adults entering or playing on treated areas post-application are evaluated. Further considerations are currently in development as OPP has committed resources and expertise to the development of specialized software and models that consider exposure to bystanders and farm workers as well as lifestyle and traditional dietary patterns among specific subgroups.

## 4.0 Hazard Characterization and Dose-Response Assessment

Malathion is a member of the OP class of pesticides. Like other OPs, the initiating event in the adverse outcome pathway (AOP)/ mode of action (MOA) for malathion involves inhibition of the enzyme AChE via phosphorylation of the serine residue at the active site of the enzyme. This inhibition leads to accumulation of acetylcholine and ultimately to neurotoxicity in the central and/or peripheral nervous system (see Figure 1). Malathion must be metabolized (activated) to the oxon metabolite (malaoxon), which is the active AChE inhibiting moiety. For malathion and malaoxon, AChE inhibition (AChEI) is a sensitive endpoint in the toxicology database in multiple species, durations, lifestages, and routes. AChEI is the focus of this hazard characterization; the availability of reliable AChE inhibition dose response data is one of the key determinants in evaluating the toxicology database.

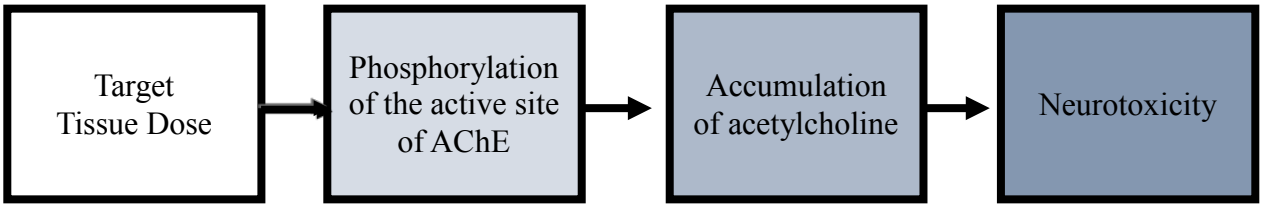



**Figure 1. Adverse outcome pathway for OPs**

In 2006, HED conducted an extensive human health risk assessment for malathion to support the Reregistration Eligibility Decision (RED) (D330680, S. Piper, 7/31/2006). In 2009, additional data from a CCA study was incorporated into the risk assessment for malathion for continued post-harvest use on rice (D361372, S. Piper, 12/10/2009). Under the current registration review, the hazard assessment is being updated based on new data received and new policies implemented post-RED. This assessment is based on the same endpoints selected in the RED since the decision logic for compartment/age group/duration is the same; however, it reflects slight changes in the values of the points of departure (POD) due to updated BMD-code (Bench Mark Dose Software 2.4 and primarily exponential modeling) (D420970, Bever and Holman, 7/1/2014). The dermal toxicity study was reassessed using a benchmark response (BMR) of 10%, instead of 20% as done previously in the RED, since the Agency no longer uses a BMR greater than 10% if peripheral AChE data (e.g., heart, lung, skeletal muscle, etc.) are not available. Since no peripheral AChE data exist for malathion, the 10% BMR will be used for registration review. Based on CCA studies with malathion and malaoxon (the oxygen degradate of malathion), with updated BMD-code modeling, the revised acute and steady state TAFs are calculated to be 22X (previously, it was 61X in the 2006 RED), which means that malaoxon is estimated to be 22 times more toxic than malathion. This TAF was applied to residues of malaoxon for risk assessment of all exposure durations, routes, and scenarios.

### 4.1 Toxicology Studies Available for Analysis

The toxicology database on malathion is complete for risk assessment. Toxicology data requirements and the toxicological profile are presented in Appendix D. There are acceptable studies available for toxicity endpoint selection. They include the following:

- Chronic oral toxicity studies in rats and dogs

- Carcinogenicity studies in rats and mice
- Developmental studies in rats and rabbits
- Reproduction study in rats
- Acute and subchronic neurotoxicity studies in rats
- Developmental neurotoxicity (DNT) study in rats
- Acute and repeated dose CCA studies in juvenile and adult rats
- Repeated, gestational AChE study in pregnant rat and fetuses
- Delayed neurotoxicity study in hens
- Subchronic dermal toxicity in rabbits
- Repeated dosing inhalation studies in rats
- Immunotoxicity study in mice
- Complete mutagenicity study battery
- Metabolism studies in rats

The malaoxon studies available for risk assessment include:

- Acute and repeated dose CCA studies in juvenile rats
- Carcinogenicity studies in rats and mice
- Complete mutagenicity study battery

## 4.2 Absorption, Distribution, Metabolism, & Excretion (ADME)

Malathion, like some other OPs, requires metabolic activation to its oxon metabolite (malaoxon) to inhibit AChE, with subsequent metabolism that leads to detoxification. Generally, absorption and distribution are rapid with extensive metabolism and no accumulation in the tissues.

Both malathion and malaoxon are detoxified by carboxyesterases leading to polar, water-soluble, compounds that are excreted. Mammalian systems show greater carboxyesterase activity, as compared with insects, so that the toxic agent malaoxon builds up more in insects than in mammals. This accounts for the increased toxicity of malathion in insects. Also, since detoxification enzymes are less developed at birth, pups have less capacity to detoxify which leads to a higher internal dose of parent/oxon for AChEI suggesting young animals may be more susceptible compared to adult animals.

In a rat metabolism study, malathion is excreted in the urine (80-90%) in the first 24 hours of exposure. Unchanged malathion was typically found to be the major residue in rats. Dicarboxylic acid and monocarboxylic acid metabolites account for the majority of the radioactivity. In the rat study, radioactivity did not bioaccumulate in any of the organ/tissues analyzed. A rat metabolism study is not available for malaoxon.

### 4.2.1 Dermal Absorption

Dermal absorption data are not available for malathion. Previously, a dermal absorption factor of 10% was estimated by comparison of the NOAELs and LOAELs in the oral developmental toxicity study and the 21-day dermal toxicity study in the same species (rabbits). However, a route specific dermal study was used to assess dermal exposure; therefore, a dermal absorption factor it is not needed for risk assessment.

## 4.3. Toxicological Effects

Malathion is an OP with a neurotoxic AOP; neurotoxicity is the most sensitive effect in all species, routes and lifestages, after oral and dermal exposure and is being used in deriving points of departure. Malathion has quality dose response data across multiple lifestages, durations, and routes for both RBC and brain AChE inhibition. Many of these studies have been evaluated using benchmark dose (BMD) modeling techniques. Based on the available data, RBC AChEI is substantially more sensitive than brain AChEI for all lifestages evaluated (adults, juveniles, pregnant dams, and fetuses) after oral and dermal exposure, and there is no sex difference regarding AChEI. However, endpoints from portal of entry effects (histopathological lesions of the nasal cavity and larynx) are shown to be more sensitive than AChEI after inhalation exposure.

Clinical signs of neurotoxicity (such as, tremors, salivation, urogenital staining, and decreased motor activity) can be found throughout the database of experimental toxicity studies at doses higher (10-fold) than those causing AChEI.

Rat and rabbit developmental toxicity studies revealed no evidence of quantitative and/or qualitative susceptibility. No maternal or developmental toxicity was observed in the rat developmental toxicity study up to the highest dose tested. In the rabbit developmental study, increased incidences of mean resorption sites were observed that can be attributed to fetal or maternal toxicity. Quantitative susceptibility was seen in the rat reproduction study where decreased pup body weights were observed during lactation period in the $F_{1a}$ and $F_{2b}$ pups in the absence of maternal toxicity (including reproductive toxicity). In the developmental neurotoxicity study there was evidence of qualitative susceptibility. Clinical signs (whole body tremors, hypoactivity, prostrate posture, partially closed eyelids) and brain morphometrics (increased thickness of the corpus callosum in PND 63-67 males and females) were seen in offspring animals in the presence of limited maternal effects (post dosing salivation). Although AChE activity was not measured in the developmental and reproduction studies, the PODs used for risk assessment, based on AChEI, are protective of the susceptibility seen in the studies. In the acute and repeat dose CCA studies, fetal animals were not more sensitive than pregnant animals to AChEI and pregnant animals were comparable to non-pregnant animals. However, young animals (PND 11) were more susceptible to RBC AChEI compared to adult animals. For OPs, there is also uncertainty in the human dose-response relationship for neurodevelopmental effects (see Section 4.4.1).

Malathion is classified as "suggestive evidence of carcinogenicity but not sufficient to assess human carcinogenic potential" by all routes of exposure (see Section 4.6.4).

Malathion exhibits low toxicity in acute lethality studies via the oral, dermal, or inhalation route (Toxicity Category III or IV). It exhibits only slight eye and dermal irritation and is not a dermal sensitizer. There is no convincing evidence for potential interaction with the estrogen, androgen or thyroid pathway.

### 4.3.1 Critical Durations of Exposure

One of the key elements in risk assessment is the appropriate integration of temporality between the exposure and hazard assessments. One advantage of an AOP understanding is that human

health risk assessments can be refined, focused on the most relevant durations of exposure. The following text provides an analysis of the temporal pattern of AChEI from acute, single dosing and repeated dosing studies in laboratory animals for malathion. This analysis provides the basis for determining which exposure durations are appropriate for assessing human health risk. Table 4.3.1.1 provides a summary of the lifestage sensitivity from high quality, well-designed CCA studies (acute and repeat phases) with malathion. Malathion has extensive AChEI data; for purposes of trend evaluation only selected data are shown below.

**Table 4.3.1.1 – Malathion $BMD_{10}$ Results (mg/kg/day) for RBC AChE Inhibition Over Time in Male and Female Rats**

| Days of dosing | Malathion Study/MRID | Sex/Lifestage | Compartment | BMD Results | |
|---|---|---|---|---|---|
| | | | | $BMD_{10}$ (mg/kg/day) | $BMDL_{10}$ (mg/kg/day) |
| **Single Dose Studies** | | | | | |
| Single dose (Adult) | MRID 45566201 CCA Study - Single dose | Adult Females /males | RBC | No BMD model obtained a good fit. NOAEL of RBC AChEI is 150 mg/kg and LOAEL is 450 mg/kg | |
| **Multiple Doses Studies** | | | | | |
| 11 days of exposure | MRID 45566201 CCA Study -Repeat Doses | Adult Males | RBC | 27.9 | 24.7 |
| 11 days of exposure | | Adult (Non-pregnant, females) | RBC | 24.0 | 21.0 |
| 15 days of exposure (GD 6-20) | | Adult (pregnant females) | RBC | 21.8 | 17.1 |

OPs exhibit a phenomenon known as steady state AChEI. After repeated dosing at the same dose, the degree of inhibition comes into equilibrium with the production of new, uninhibited enzyme. At this point, the amount of AChEI at a given dose remains consistent across duration. In general, OPs reach steady state within 2-3 weeks but this can vary among OPs. For malathion, the results in Table 4.3.1.1 show a clear pattern of steady state reached by 11-15 days of exposure. As such, the endpoint selection for malathion focuses on acute (single day) effects, and steady state effects (21 days and longer).

Although the durations of the toxicity and exposure assessments may differ among the OPs, an exact match is not necessary and would suggest a level of precision that the toxicity data do not support. Given this, the 21-day and longer exposure assessment is scientifically supportable and also provides consistency with the OP cumulative risk assessment (OP Cumulative Risk Assessment (CRA; 2002, 2006) and across the single chemical risk assessment for the OPs. As such, the single chemical OP assessment will evaluate steady state (a 21-day assessment) instead of the typical chronic duration dietary assessment. The steady state point of departure is protective of any exposure duration longer than 21-days, including chronic exposure, since cholinesterase inhibition does not increase after reaching maximum inhibition or steady state.

## 4.4 Literature Search and Review

### 4.4.1 Literature Review on Neurodevelopment Effects

For the OPs, historically the Agency has used inhibition of AChE as the POD for human health risk assessment; at present time, this policy continues. This science policy is based on decades of work which shows that AChE inhibition is the initial event in the pathway to acute cholinergic

neurotoxicity. The use of AChE inhibition data for deriving PODs was supported by the FIFRA SAP (2008, 2012) for chlorpyrifos as the most robust source of dose-response data for extrapolating risk and is the source of data for PODs for malathion. A detailed review of the epidemiological studies used in this review can be found either in the 2014 chlorpyrifos revised draft human health risk assessment (D424485, D. Drew et al., 12/29/2014) or in the 2015 literature review for other organophosphates (OPP/USEPA; D331251; 9/15/15).

Newer lines of research on OPs in the areas of potential AOPs, *in vivo* animal studies, and notably epidemiological studies in mothers and children, have raised some uncertainty about the agency's risk assessment approach with regard to the potential for neurodevelopmental effects in fetuses and children. Many of these studies have been the subject of review by the agency over the last several years as part of efforts to develop a risk assessment for chlorpyrifos (D424485, D. Drew et al., 12/29/2014). Initially, the agency focused on studies from three US cohorts: 1) The Mothers and Newborn Study of North Manhattan and South Bronx performed by the Columbia Children's Center for Environmental Health (CCCEH) at Columbia University; 2) the Mt. Sinai Inner-City Toxicants, Child Growth and Development Study or the "Mt. Sinai Child Growth and Development Study;" and 3) the Center for Health Assessment of Mothers and Children of Salinas Valley (CHAMACOS) conducted by researchers at University of California Berkeley. The agency has evaluated these studies and sought external peer review (FIFRA SAP reviews in 2008 and 2012; federal panel, 2013[2]) and concludes they are of high quality. In the three US epidemiology cohort studies, mother-infant pairs were recruited for the purpose of studying the potential health effects of environmental exposures during pregnancy on subsequent child development. Each of these cohorts evaluated the association between prenatal chlorpyrifos and/or OP exposure (with adverse neurodevelopmental outcomes in children through age 7 years. For the 2014 chlorpyrifos revised human health risk assessment (D424485, D. Drew et al., 12/29/2014), EPA included epidemiologic research results from these three US prospective birth cohort studies but primarily focused on the results of CCCEH since this cohort has published studies on the association between cord blood levels of chlorpyrifos and neurodevelopmental outcomes. The agency retained the FQPA 10X Safety Factor (SF) in the 2014 chlorpyrifos revised risk assessment, in large part, based on the findings of these studies.

In the 2015 updated literature review (OPP/USEPA; D331251; 9/15/15), the agency conducted a systematic review expanding the scope of the 2012/2014 review focused on US cohort studies with particular emphasis on chlorpyrifos. The expanded 2015 review includes consideration of the epidemiological data on any OP pesticide, study designs beyond prospective cohort studies, and non-U.S. based studies. The updated literature review identified seven studies which were relevant (Bouchard et al., 2010; Fortenberry et al., 2014; Furlong et al., 2014; Guodong et al., 2012; Oulhote and Bouchard, 2013; Zhang et al., 2014; Shelton et al., 2014). These seven studies have been evaluated in context with studies from the 2012/2014 review (D424485, D. Drew et al., 12/29/2014). Only a brief summary is provided below.

The OP exposure being assessed in many of these studies used concentrations of urinary dialkyl phosphate metabolites (DAPs) as the urinary biomarker. Total DAPs is a non-specific measure of OP exposure and is the sum of six separate molecules - three dimethyl alkylphosphate (DMAP) molecules of DMP, DMTP, DMDTP, and three diethyl alkylphosphate (DEAP)

[2] http://www.regulations.gov/#!documentDetail;D=EPA-HQ-OPP-2008-0850-0170

molecules of DEP, DETP, and DEDTP. Each metabolite is a breakdown product from multiple OPs (Table 4.4.-1; CDC, 2008)[3]. Specifically, DMP, DMTP, and DMDTP are associated with 18, 13, and 5 OPs, whereas DEP, DETP, and DEDTP are associated with 10, 10, and 4 OPs, respectively. Thus, using urinary DAPs alone as an exposure measure, it is not possible to separate the exposure and associated effects for single, specific OPs.

**Table 4.4.1. CDC Table of organophosphate pesticides and their dialkyl phosphate metabolites (2008).**

| Pesticide | DMP | DMTP | DMDTP | DEP | DETP | DEDTP |
|---|---|---|---|---|---|---|
| Azinphos methyl | X | X | X | | | |
| Chlorethoxyphos | | | | X | X | |
| Chlorpyrifos | | | | X | X | |
| Chlorpyrifos methyl | X | X | | | | |
| Coumaphos | | | | X | X | |
| Dichlorvos (DDVP) | X | | | | | |
| Diazinon | | | | X | X | |
| Dicrotophos | X | | | | | |
| Dimethoate | X | X | X | | | |
| Disulfoton | | | | X | X | X |
| Ethion | | | | X | X | X |
| Fenitrothion | X | X | | | | |
| Fenthion | X | X | | | | |
| Isazaphos-methyl | X | X | | | | |
| Malathion | X | X | X | | | |
| Methidathion | X | X | X | | | |
| Methyl parathion | X | X | | | | |
| Naled | X | | | | | |
| Oxydemeton-methyl | X | X | | | | |
| Parathion | | | | X | X | |
| Phorate | | | | X | X | X |
| Phosmet | X | X | X | | | |
| Pirimiphos-methyl | X | X | | | | |
| Sulfotepp | | | | X | X | |
| Temephos | X | X | | | | |
| Terbufos | | | | X | X | X |
| Tetrachlorviphos | X | | | | | |
| Trichlorfon | X | | | | | |

DMP = dimethylphosphate; DEP = diethylphosphate; DMTP = dimethylthiophosphate; DMDTP = dimethyldithiophosphate; DETP = diethylthiophosphate; DEDTP = diethyldithiophosphate.

For studies which measured urinary 3,5,6-trichloro-2-pyridinol (TCPy) (e.g., Fortenberry et al., 2014; Eskenazi et al., 2007; Whyatt et al., 2009), this metabolite can be derived from chlorpyrifos, chlorpyrifos-methyl, and the herbicide triclopyr. TCPy is also the primary environmental degradate of chlorpyrifos, chlorpyrifos-methyl, and triclopyr; thus exposure can be found directly on food treated with these pesticides. CCCEH studies have largely used chlorpyrifos measured in cord blood as the specific biomarker (e.g., Lovasi et al., 2010; Whyatt

[3] http://www.cdc.gov/nchs/data/nhanes/nhanes_03_04/l26opd_c_met_organophosphorus_pesticides.pdf

et al., 2004; Rauh et al., 2011). The CHARGE study (Shelton et al., 2015) did not measure biomarkers but instead used geospatial analysis to focus on the residential proximity to OP exposure using data from the California Department of Pesticide Regulation, with five OPs accounting for a total of 73% of the pesticide applied near residential settings (chlorpyrifos, acephate, diazinon, bensulide, and dimethoate).

Similarly, DAPs can be found directly on food following OP applications (Zhang et al., 2008; Chen et al., 2012). Specifically, studies have shown that DAPs may form as environmental degradates from abiotic hydrolysis, photolysis, and plant metabolism (Zhang et al., 2008; Chen et al., 2012; Racke et al., 1994). Furthermore, since these DAPs are excreted more rapidly and extensively than the parent OPs (Zhang et al., 2008; Forsberg et al., 2008), direct exposure to DAPs may lead to an overestimate of OP exposure when using urinary DAPs as a biomarker of OP exposure. The agency recognizes that this is a source of uncertainty when using DAPs for assessing OP exposure and will continue to monitor this issue in future assessments.

With respect to neurological effects near birth, the CHAMACOS and Mt. Sinai cohorts measured neurological effects at birth, and observed a putative association with total DEAP, total DMAP, and total DAP exposure (Engel et al., 2007; Young et al., 2005). Similarly, a Chinese study (Zhang et al., 2014) reported statistically significant associations between for total DEAPs, total DMAPs, and total DAPs from prenatal OP pesticide exposure and neonatal neurodevelopment assessed 3 days after birth. However, another cross-sectional Chinese study, Guodong et al. (2012), observed no association with urinary DAPs and a developmental quotient score for 23-25 month old children.

In addition, there has been a limited evaluation of the association between malathion carboxylic acid (MDA, a malathion metabolite) exposure and neurological effects at or near birth in the CHAMACOS and Mt. Sinai cohorts. Specifically, there was no association observed between MDA exposure above the limit of detection and neurological effects at birth in the CHAMACOS cohort (Eskenazi et al, 2007), whereas MDA exposure above the limit of detection was associated with an elevated risk of abnormal neonatal reflexes in the Mt. Sinai cohort (Engel et al, 2007).

The 3 US cohorts (CCCEH, Mt. Sinai, CHAMACOS) each reported evidence of impaired mental and psychomotor development, albeit not consistent by age at time of testing (ranging from 6 month to 36 months across the three cohorts). Attentional problems and ADHD were reported by three prospective cohorts [Rauh et al., 2006; Eskenazi et al., 2007; Marks et al., 2010; and Fortenberry et al. (2014)] investigators with additional support from a case control study, Bouchard et al. (2010). The exposure metric varied among these studies. Specifically, Fortenberry et al. (2014) found suggestive evidence of an association with TCPy and ADHD in boys, whereas statistically significant associations were observed by Rauh et al. (2006) with chlorpyrifos exposure and ADHD. Eskenazi et al. (2007) reported associations with total DMAPs and total DAPs and ADHD; Marks et al. (2010) reported associations with total DEAP, DMAP, and total DAP exposure and ADHD. In a national cross-sectional study of Canadian children, using 2007-2009 data for children age 6-11 years (Oulhote and Bouchard, 2013), there were no overall statistically significant associations observed between child urinary DEAP, DMAP, or total DAP metabolite levels and parentally reported behavioral problems. In contrast, Bouchard et al. (2010), looking at U.S. children age 8-15 years in the 2000-2004 National Health and Nutrition Examination Survey (NHANES), observed a positive association between

attention and behavior problems and total DAPs and DMAPs, but not DEAPs. As part of their analysis, Oulhote and Bouchard (2013) noted that their outcome assessment for behavioral problems may not have been as sensitive as Bouchard et al. (2010), which may in part account for the difference in the observed results from these studies.

In addition, the three US cohorts and the CHARGE study have reported suggestive or positive associations between OP exposure and autism spectrum disorders (Rauh et al., 2006; Shelton et al., 2014; Eskenazi et al., 2007; Furlong et al., 2014). Specifically, Furlong et al. (2014) documented suggestive evidence of an association between total DEAP exposure and reciprocal social responsiveness among blacks and boys. Eskenazi et al. (2007) reported a statistically significant association between pervasive developmental disorder (PDD) and total DAP exposure, whereas Eskenazi et al. (2010) reported non-significant, but suggestive, increased odds of PDD of 2.0 (0.8 to 5.1; p=0.14). Rauh et al. (2006) documented a significant association between PDD and specifically chlorpyrifos exposure. Both PDD and reciprocal social responsiveness are related to the autism spectrum disorder. Using a different exposure assessment method (geospatial analysis and residential proximity to total OP exposure), Shelton et al. (2014) also showed statistically significant associations between total OP exposure and ASD. While these studies vary in the magnitude of the overall strength of association, they have consistently observed a positive association between OP exposure and ASD. Finally, CCCEH, Mt. Sinai, CHAMACOS have reported an inverse relation between the respective prenatal measures of chlorpyrifos and intelligence measures at age 7 years (Rauh et al., 2011; Engel et al., 2011; Bouchard et al., 2011).

Across the epidemiology database of studies, the maternal urine, cord blood, and other (meconium) measures provide evidence that exposure did occur to the fetus during gestation but the actual level of such exposure during the critical window(s) of susceptibility is not known. While significant uncertainties remain about the actual exposure levels experienced by mothers and infant participants in the children's health cohorts, it is unlikely that these exposures resulted in AChE inhibition. As part of the CHAMACOS study, Eskenazi et al. (2004) measured AChE activity and showed that no differences in AChE activity were observed. The biomarker data (chlorpyrifos) from the Columbia University studies are supported by the agency's dose reconstruction analysis using the PBPK-PD model (D424485, D. Drew et al., 12/29/2014). Following the recommendation of the FIFRA SAP (2012), the agency conducted a dose reconstruction analysis of residential uses available prior to 2000 for pregnant women and young children inside the home. The PBPK-PD model results indicate for the highest exposure considered (i.e., indoor broadcast use of a 1% chlorpyrifos formulation) <1% RBC AChE inhibition was produced in pregnant women. While uncertainty exists as to actual OP exposure at (unknown) critical windows of exposure, EPA believes it is unlikely individuals in the epidemiology studies experienced RBC AChE inhibition.

A review of the scientific literature on potential modes of action/adverse outcome pathways (MOA/AOP)[4] leading to effects on the developing brain was conducted for the 2012 FIFRA SAP meeting (USEPA, 2012) and updated for the December 2014 chlorpyrifos revised risk assessment (D424485, D. Drew et al., 12/29/2014). In short, multiple biologically plausible hypotheses and pathways are being pursued by researchers that include targets other than AChE

[4] Mode of action (MOA) and adverse outcome pathways (AOPs) describe a set of measureable key events that make up the biological processes leading to an adverse outcome and the causal linkages between such events.

inhibition, including cholinergic and non-cholinergic systems, signaling pathways, proteins, and others. However, no one pathway has sufficient data to be considered more credible than the others. The fact that there are, however, sparse AOP data to support the *in vitro* to *in vivo* extrapolation, or the extrapolation from biological perturbation to adverse consequence significantly limits their quantitative use in risk assessment. The SAP concurred with the agency in 2008 and 2012 about the lack of definable key events in a MOA/AOP leading to developmental neurobehavioral effects. However, since the 2014 literature review, there are no substantive changes in the ability to define and quantitate steps in an MOA/AOP leading from exposure to effects on the developing brain. Published and submitted guideline DNT laboratory animal studies have been reviewed for OPs as part of the 2012/2014 review (D424485, D. Drew et al., 12/29/2014) and the updated 2015 review (OPP/USEPA; D331251; 9/15/15). Neurobehavioral alterations in laboratory animals were often reported, albeit at AChE inhibiting doses, but there was generally a lack of consistency in terms of pattern, timing, or dose-response for these effects, and a number of studies were of lower quality. However, this information does provide evidence of long-lasting neurodevelopmental disorders in rats and mice following gestational exposure.

At this time, a MOA(s)/AOP(s) has/have not been established for neurodevelopmental outcomes. This growing body of literature does demonstrate, however, that OPs are biologically active on a number of processes that affect the developing brain. Moreover, there is a large body of *in vivo* laboratory studies which show long-term behavioral effects from early life exposure, albeit at doses which cause AChE inhibition. EPA considers the results of the toxicological studies relevant to the human population, as qualitatively supported by the results of epidemiology studies. The agency acknowledges the lack of established MOA/AOP pathway and uncertainties associated with the lack of ability to make strong causal linkages and unknown window(s) of susceptibility. These uncertainties do not undermine or reduce the confidence in the findings of the epidemiology studies. The epidemiology studies reviewed in the 2012/2014 and 2015 literature reviews represent different investigators, locations, points in time, exposure assessment procedures, and outcome measurements. Despite all these differences in study design, with the exception of two negative studies in the 2015 literature review (Guodong et al., 2012; Oulhote and Bouchard, 2013), authors have identified associations with neurodevelopmental outcomes associated with OP exposure across four cohorts and twelve study citations. Specifically, there is evidence of delays in mental development in infants (24-36 months), attention problems and autism spectrum disorder in early childhood, and intelligence decrements in school age children who were exposed to OPs during gestation. Investigators reported strong measures of statistical association across several of these evaluations (odds ratios 2-4 fold increased in some instances), and observed evidence of exposures-response trends in some instances, ***e.g.***, intelligence measures.

As section 408(b)(2)(C) of the FFDCA instructs EPA, in making its "reasonable certainty of no harm" finding, that in "the case of threshold effects, an additional tenfold margin of safety for the pesticide chemical residue and other sources of exposure shall be applied for infants and children to take into account potential pre- and postnatal toxicity and completeness of data with respect to exposure and toxicity to infants and children." Section 408 (b)(2)(C) further states that "the Administrator may use a different margin of safety for the pesticide chemical residue only if, on the basis of reliable data, such margin will be safe for infants and children." Given the totality of the evidence, there is sufficient uncertainty in the human dose-response relationship for neurodevelopmental effects which prevents the agency from reducing or removing the statutory

10X FQPA Safety Factor. For the malathion draft risk assessment, a value of 10X FQPA SF has been retained. Similarly, a database uncertainty factor of 10X will be applied for occupational risk assessments. The agency will continue to evaluate the epidemiology studies and pursue approaches for quantitative or semi-quantitative comparisons between doses which elicit AChE inhibition and those which are associated with neurodevelopmental outcomes prior to a revised human health risk assessment.

### 4.4.2 Incident and Epidemiological Data Review

Malathion Tier II Incident Report, D423155, 9/30/14, S. Recore, et al.
Addendum to Tier II Incident Report dated 09/30/14, D426077, 6/10/2016, C. Williams, et al.

HED's review of the available acute pesticide poisoning event reporting and surveillance systems indicate acute exposure to malathion results in predictable and documented organophosphate acute effects. These include neurological, gastrointestinal and respiratory effects, primarily. HED did not identify any aberrant effects outside of those anticipated and documented as a result of general OP toxicity. Acute adverse health effects due to OP/malathion exposure are generally mild to moderate and are reversible with primary medical intervention. Exposure scenarios observed in the acute event reporting databases are the same identified in the risk assessment, and do not indicate higher than average potential for human error, misuse or accidental exposure. The time period of HED's review of acute pesticide poisoning events reported to various reporting and surveillance systems overlaps the period of cancellation of indoor residential uses and significant modifications to the label including removal of certain agricultural crops (2008). While it is not possible to discern whether a specific event is the result of a currently available or cancelled product or use site, in general the reduction in poisoning events over time is likely due to the product cancellations or use site restrictions that took place at the time of the malathion RED.

Medical case reports indicate that although malathion is considered one of the least toxic organophosphate pesticides, exposure to malathion at sufficiently high doses from accidental or intentional misuse can cause severe acute cholinergic crisis, Intermediate syndrome, Organophosphate Induced Delayed Neuropathy and a Parkinson's-like syndrome. These health effects have been documented in the past, and are not outside the scope of what is expected upon high acute exposure to a neurotoxic, cholinesterase-inhibiting pesticide.

Malathion is currently classified as having "suggestive evidence of carcinogenicity" based upon animal cancer bioassays although data are insufficient to (quantitatively) assess the carcinogenic potential of the chemical. The epidemiology database concerning malathion is relatively large with a variety of health outcomes evaluated. The size of the total database likely reflects the high prevalence of use of this OP insecticide, as well as the long duration of use in agriculture as well as the residential environment (malathion was first registered for use in the U.S. several decades ago). In the majority of these studies, authors conclude there is no evidence of an association with malathion use, specifically. However, EPA does note a few areas of suggestive associations in which malathion may play a role in the health outcome. These data should be further investigated by researchers and will be followed by EPA as additional data are published. At the time of this writing, the review of the available epidemiologic evidence considered independently is not sufficient to support a conclusion that additional hazard identification and exposure-response modeling in needed within the risk assessment.

There are over two dozen studies of the potential carcinogenic effect of malathion exposure in the human population. Overall, the data do not provide compelling evidence that malathion plays a role in the development of these cancers; however this review highlighted several malathion-chronic disease associations that EPA will continue to follow. Specifically, this involves the literature concerning the preliminary, suggestive association with not total prostate cancer, but rather the aggressive form of the disease; replication in a study population external to the AHS is warranted. In investigations of malathion exposure and various sub-types of lymphohematopoietic cancers, authors either did not report significant, positive associations with malathion use (Hodgkin lymphoma, soft tissue sarcoma), or could not fully exclude the role of chance or bias in the interpretation of the modest positive associations observed (leukemia, multiple myeloma), or the results across studies were inconsistent in nature (NHL). Prospective studies of the association between chronic pesticide exposure and lymphohematopoietic cancer are needed to overcome the limitations of population based case-control studies, including recall bias and exposure misclassification.

In a series of studies of adverse respiratory health effects studied primarily within the AHS, the role of malathion remains difficult to discern. These studies were hypothesis-generating in nature, making multiple statistical comparisons in relation to each respiratory health effect. There is some evidence of a positive statistical association between malathion use and wheeze, asthma and chronic bronchitis; however, each of these studies were hypothesis-generating in nature in which authors performed multiple statistical comparisons primarily using a cross-sectional design. We note that there is inconsistent evidence of a role— protective, adverse, or otherwise -- for pre-existing atopy (allergy, eczema) in the relation between chemical exposure and wheeze. Therefore, the role for malathion exposure in adverse respiratory health outcomes remains a challenge to discern, and additional studies will be evaluated as they become available.

Similarly, there are several studies of the potential role of malathion exposure and adverse birth outcomes or developmental effects within this database. Studies of in utero malathion exposure (maternal urinary concentration of MDA) and birth outcomes (e.g., birth weight and length) (2 studies), adverse neurodevelopmental effects (2 studies), and birth defects (3 studies) did not observe evidence of a positive statistical association. In a prospective cohort study (Mt. Sinai birth cohort study), authors reported a significant association with the number of abnormal reflexes in the exposed neonate; however there is only one study of this particular association. EPA will continue to monitor the three major US environmental public health birth cohort studies as well as other data sources for additional information concerning malathion exposure specifically as these data become available.

Studies of malathion exposure in association with myocardial infarction; hyper- and hypo-thyroid disease; retinal degeneration; Parkinson's disease; neurological functioning in adults; and male reproductive effect (semen parameters) are negative (no statistical evidence of an association with malathion specifically). EPA notes most of these studies were hypothesis-generating in nature, multiple statistical tests were performed, and authors proffered few a priori hypotheses. In a study of insulin resistance and diabetes, authors reported a significant relation with malathion; however the complex relationships between co-factors in the association and the quality of statistical adjustment within the study requires additional research before a role for malathion can be elucidated.

The malathion cancer epidemiology studies are mostly null or demonstrate statistically non-significant findings. For those studies in which results were suggestive, malathion was not hypothesized as a risk factor for disease (they were hypothesis- generating in nature) and many studies were performed within only a few study populations (such as the AHS or the pooled Midwest case-control study series). The recent preliminary finding with not total prostate cancer but only the aggressive from of the disease lacks a biological understanding at this time. EPA will continue to monitor this literature as it develops.

## 4.5 Safety Factor for Infants and Children (FQPA SF)

As noted above, the lack of an established MOA/AOP makes quantitative use of the epidemiology studies in risk assessment challenging, particularly with respect to determining dose-response, critical duration of exposure, and window(s) of susceptibility. Furthermore, exposure levels in the range measured in the epidemiology studies are likely low enough that they are unlikely to result in AChE inhibition. Epidemiology studies consistently identified associations with neurodevelopmental outcomes associated with prenatal OP exposure such as delays in mental development in infants (24-36 months), attention problems and autism spectrum disorder in early childhood, and intelligence decrements in school age children. Therefore, there is a need to protect infants, children, youths, and women of childbearing age from exposures that may cause these effects; this need prevents the Agency from reducing or removing the statutory FQPA Safety Factor. Thus, the FQPA 10X Safety Factor will be retained for malathion for the population subgroups that include infants, children, youth, and women of childbearing age for all exposure scenarios.[5]

### 4.5.1 Completeness of the Toxicology Database

The existing toxicological database is complete and adequate for risk assessment. Available malathion studies for FQPA evaluation include developmental studies in the rat and rabbit, reproductive toxicity studies, CCA studies (acute, repeated dose, gestational), and neurotoxicity studies (acute, subchronic, and developmental). In addition, CCA studies (acute and repeated dose) for malaoxon in juvenile rats are also available.

### 4.5.2 Evidence of Neurotoxicity

Malathion is an OP with a neurotoxic MOA/AOP; neurotoxicity (AChEI) is the most sensitive effect in all species, routes, and lifestages after oral and dermal exposure; oral and dermal risk assessments are based on AChEI. For inhalation exposure, portal-of-entry (histopathological lesions of the nasal cavity and larynx) effects are observed at a dose lower than the dose causing AChEI and are used for risk assessment and are considered protective of neurotoxicity by the inhalation route.

### 4.5.3 Evidence of Sensitivity/Susceptibility in the Developing or Young Animal

As described in Section 4.3, there is evidence that following acute or repeated dosing to malathion, young animals (PND 11) are more sensitive than adult animals to RBC AChEI.

[5] HED's standard toxicological, exposure, and risk assessment approaches are consistent with the requirements of EPA's children's environmental health policy (https://www.epa.gov/children/epas-policy-evaluating-risk-children).

Therefore, data from pups, the most sensitive lifestage, were used to determine the appropriate POD for risk assessments for acute and steady state dietary and incidental oral exposure scenarios. The risk assessments are also protective of the increased susceptibility observed in the rat reproduction and developmental neurotoxicity studies.

In addition, as discussed in Section 4.4.1, there is uncertainty in the human dose-response relationship for neurodevelopmental effects and this warrants retention of the FQPA Safety Factor for the population subgroups that include infants, children, youth, and women of childbearing age for all exposure scenarios.

### 4.5.4 Residual Uncertainty in the Exposure Database

There are no residual uncertainties in the exposure database. The mostly refined dietary risk assessment uses food residue levels from monitoring data and from empirical studies and model-estimated drinking water concentrations from maximum application rates. Residential exposure assessments use data from surrogate and chemical-specific sources. The exposure assumptions will not underestimate risks.

## 4.6 Toxicity Endpoint and Point of Departure Selections

### 4.6.1 Dose-Response Assessment

Table 4.6.5.1 summarizes the toxicity endpoints and PODs selected from the malathion database. This endpoint selection was based on a weight-of-the evidence (WOE) evaluation using the following considerations:

- *Relative sensitivity of the brain and RBC compartments*: For malathion and malaoxon, across most studies, durations, lifestages, and routes, the RBC compartment tends to be more sensitive. As such OPP has emphasized the use of RBC data in POD derivation for malathion.
- *Potentially susceptible populations (fetuses, juveniles, pregnancy*): The available AChE data across multiple lifestages (adults, pregnant adults, fetus, juveniles) shows that that PND 11 pups are more sensitive than adults to RBC AChEI. Fetuses are not more sensitive than pregnant animals and pregnant dams have a similar sensitivity to non-pregnant female adults. Additionally, there is no sex difference on RBC AChEI.
- *Route of exposure:* It is preferred to match, to the degree possible, the route of exposure in the toxicity study with that of the exposure scenario(s) of interest. In the case of malathion, there are oral, dermal, and inhalation studies which contain high quality dose response AChE data.
- *Duration of exposure:* It is preferred to match, to the degree possible, the duration of toxicity study with that of the exposure duration of interest. In the case of malathion, there are single day and repeated dosing oral studies, but only repeated dosing dermal and inhalation studies are available. In addition, there are single day and repeated dosing oral studies with malaoxon.
- *Consistency across studies:* In cases where multiple datasets are available for a single duration, it is important to evaluate the extent to which data are consistent (or not) across studies. The malathion database is consistent across studies which allows for PODs to be derived from multiple critical studies thereby increasing the confidence in such values.

*Acute Dietary*

Multiple CCA studies provided the best dataset for this exposure scenario since the dose and endpoint selections were based on pups, the most sensitive lifestage. The malathion database is consistent across studies which allows for PODs to be derived from multiple critical studies and, therefore, increasing the confidence in the values. As shown in the Appendix D3. Table C.1, the $BMDL_{10}$ values from acute and repeated dosing in juvenile rat pups range from 10 to 14 mg/kg/day. A POD of 10 mg/kg/day was selected for acute dietary (all populations) exposure scenarios which are lower than any PODs for adult oral exposure. An uncertainty factor (UF) of 1000X (10X for interspecies extrapolation, 10X for intraspecies variation and 10X for FQPA SF due to uncertainty in the human dose-response relationship for neurodevelopmental effects (see Section 4.4.1)) is applied to the POD to obtain an acute population adjusted dose (aPAD) of 0.01 mg/kg (aRfD=0.1 mg/kg) for exposure scenarios with infants, children, youth, and women of childbearing age. The only population subgroup for which the FQPA SF is not retained is adults 50-99 years old; therefore, the aPAD for this population subgroup is 0.1 mg/kg/day (aRfD= 0.1 mg/kg).

*Steady-State Dietary*

Similar to acute dietary, multiple CCA studies provided the best dataset for this exposure scenario. Since similar $BMDL_{10}$ values were obtained following acute or repeated exposures in juvenile rat pups with results ranged from 10 to 14 mg/kg/day. A POD of 10 mg/kg/day was selected for steady-state dietary (all populations) exposure scenarios and was considered appropriate since the dose and endpoint selections were based on pups, the most sensitive lifestage. An uncertainty factor (UF) of 1000X (10X for interspecies extrapolation, 10X for intraspecies variation and 10X for FQPA SF due to uncertainty in the human dose-response relationship for neurodevelopmental effects (see Section 4.4.1)) is applied to the POD to obtain a steady state population adjusted dose (ssPAD) of 0.01 mg/kg (ssRfD= 0.1 mg/kg/day) for exposure scenarios with infants, children, youth, and women of childbearing age. The only population subgroup for which the FQPA SF is not retained is adults 50-99 years old; therefore, the ssPAD for this population subgroup is 0.1 mg/kg/day (ssRfD=0.1 mg/kg/day).

*Incidental Oral, Steady State*

For the purpose of assessing potential risk associated with incidental oral exposure from steady state durations resulting from spray drift, a POD of 10 mg/kg/day was selected from multiple CCA studies as described above. Sub-populations of interest (infants, toddlers, young children) are accounted for because the endpoint is based on pups, the most sensitive lifestage. An uncertainty factor (UF) of 1000X (10x for interspecies extrapolation, 10X for intraspecies variation and 10X for FQPA SF due to uncertainty in the human dose-response relationship for neurodevelopmental effects (see Section 4.4.1)) is applied.

*Dermal, Steady State*

Based on the use pattern for malathion, only a steady-state dermal POD is required. A steady state dermal POD of 80 mg/kg/day ($BMDL_{10}$) was selected from a 21-day dermal toxicity study in rabbits (MRID 46790501) based on RBC AChEI in the female rabbits. The corresponding

$BMD_{10}$ was 124 mg/kg/day. A total uncertainty factor of 1000X is appropriate for dermal exposures (10X for interspecies extrapolation, 10X for intraspecies variation, and a 10X FQPA SF for residential assessments or a database uncertainty factor in occupational assessments due to uncertainty in the human dose-response relationship for neurodevelopmental effects (see Section 4.4.1)).

As discussed above, there is evidence that young animals are more susceptible compared to adult animals following acute or repeated oral doses exposure to malathion. Although the rabbit dermal study only uses adult animals, a dermal POD derived from adult animals is considered protective of the young. An alternative approach to assessing dermal exposure to children would be to use the oral POD of 10 mg/kg/day derived from the pup data to extrapolate a dermal POD with a conservative dermal absorption factor (10%). The route to route extrapolation of the pup effects would yield a dermal equivalent POD of 100 mg/kg/day which is higher than the rabbit dermal $BMDL_{10}$ of 80 mg/kg/day. Therefore, a dermal POD of 80 mg/kg derived from adult animals is considered protective of the young.

*Inhalation, Short (1-30 days) and intermediate (1-6 months)*

Based on the use pattern for malathion, only a short (1-30 days) and intermediate-term (1-6 months) exposure is anticipated. A route-specific inhalation study was used for inhalation risk assessment based on portal-of-entry effects such as histopathological lesions of the nasal cavity and the larynx at the LOAEL of 0.1 mg/L. The portal-of-entry NOAEL was not established in this study. This inhalation endpoint was selected because the lesions were noted at a dose lower than the dose which resulted in AChEI and the lesions were observed in both short- and long-term studies; therefore, the POD based on portal-of-entry is considered protective of AChEI. Also, since inhalation exposure is only expected for occupational and residential handlers, using data derived from adults animals is appropriate given fetuses are not more sensitive than pregnant animals and pregnant dams have a similar sensitivity to non-pregnant female adults. As a result, the selected endpoint is considered protective of pregnant workers.

The methods and dosimetry equations described in EPA's reference concentration (RfC) guidance (1994) are suited for calculating HECs based on the inhalation toxicity point of departure (NOAEL, LOAEL, or BMDL) for use in MOE calculations. The regional-deposited-dose ratio (RDDR), which accounts for the particulate diameter (mass median aerodynamic diameter [MMAD] and geometric standard deviation [$\sigma_g$] of aerosols), can be used to estimate the different dose fractions deposited along the respiratory tract. The RDDR is also based on interspecies differences in ventilation and respiratory-tract surface areas. Thus, the RDDR can be used to adjust an observed inhalation particulate exposure of an animal to the predicted inhalation exposure for a human.

The standard interspecies extrapolation uncertainty factor can be reduced from 10X to 3X due to the HEC calculation accounting for pharmacokinetic (not pharmacodynamic) interspecies differences. The intraspecies uncertainty factor remains at 10X. For inhalation exposures, the maximum total uncertainty factor of 3000X (3X for interspecies extrapolation, 10X for intraspecies variation, 10X for a LOAEL to NOAEL extrapolation and 10X database uncertainty factor incorporating uncertainty in the human dose-response relationship for neurodevelopmental effects (see Section 4.4.1) was applied.

### 4.6.2 Toxicity Adjustment Factor for Malaoxon

Malaoxon, the oxygen degradate of malathion, can be formed in the environment under certain conditions. As the oxon metabolite of malathion, malaoxon is a more potent AChE inhibitor. EPA has performed BMD modeling on CCA studies of malathion and malaoxon to evaluate relative potency for malathion and malaoxon and to estimate a TAF to account for the increased potency of malaoxon in estimates of risk.

Ideally, TAFs are needed for acute and 'steady state' exposure durations. As shown in the OP cumulative risk assessment, for most OPs, AChEI reaches steady state following approximately 21 days of oral exposure (USEPA, 2002). Once steady state is reached BMD values are generally consistent and do not change with longer exposures.

As described in the guidance document for cumulative risk assessment (USEPA, 2002), comparisons of toxic potency should be made using a uniform basis of comparison, by using to the extent possible a common response derived from a comparable measurement methodology, species, and sex for all the exposure routes of interest. Dose-response modeling is preferred over the use of NOAEL/LOAELs (i.e., no or low observed adverse effect levels) for determining relative toxic potency and calculating TAFs since NOAELs and LOAELs do not necessarily reflect the relationship between dose and response for a given chemical, nor do they reflect a uniform response across different chemicals.

To calculate the ratio of toxicity between malathion and malaoxon, the Agency utilized BMD modeling of the data from a special acute and repeat dose CCA studies with malaoxon and malathion in juvenile animals, which was used to determine the TAFs. In the 2006 RED, the Agency estimated a steady state TAF for RBC AChEI to be 61X with upper and lower confidence limit of 170 and 22, respectively. In the current risk assessment, based on CCA studies with malathion and malaoxon with up-dated BMD modeling on RBC AChEI in pup female rats, the acute and steady state TAF is calculated to be 22X, meaning malaoxon is estimated to be 22 times more toxic than malathion (Table 4.6.2.1 and 4.6.2.2). This TAF is applied to residues of malaoxon for risk assessment of all exposure durations, routes, and scenarios.

**Table 4.6.2.1 Benchmark dose calculations ($BMD_{10}$) for RBC cholinesterase inhibition in pup rats (PND 11) with single dose of malathion and malaoxon.**

| | MALE | FEMALE |
|---|---|---|
| **Malathion** | 13.8 | 12.9 |
| **Malaoxon** | NF | 0.60 |
| **'Acute' Toxicity Adjustment Factor** | **NA** | **21.5 (≈ 22X)** |

NF indicates that no BMD model obtained good fit.
NA indicates not applicable.
The TAF was calculated using the malathion (female RBC AChEI) $BMD_{10}$ of 12.9 divided by the malaoxon $BMD_{10}$ of 0.60, therefore, 12.9/0.60 = 21.5 (≈ 22) (MRID 47373704)

| Table 4.6.2.2 Benchmark dose calculations ($BMD_{10}$) for RBC cholinesterase inhibition in pup rats (PND 11-21) with repeated doses of malathion and malaoxon. | | |
|---|---|---|
| | **MALE** | **FEMALE** |
| **Malathion** | 13.3 | 13.1 |
| **Malaoxon** | 0.84 | 0.61 |
| **'Steady State' Toxicity Adjustment Factor** | 15.8 | **21.5 (≈ 22X)** |
| The TAF was calculated using the malathion (female RBC AChEI) $BMD_{10}$ of 13.1 divided by the malaoxon $BMD_{10}$ of 0.61, therefore, 13.1/0.61 = 21.5 (≈ 22) (MRID 46822201) | | |

### 4.6.3 Recommendation for Combining Routes of Exposures for Risk Assessment

According to FQPA (1996), when there are potential residual exposures to a pesticide, an aggregate risk assessment must consider exposures from 3 major routes: oral, dermal, and inhalation. PODs for the oral and dermal routes are derived from RBC AChEI; therefore, these routes may be combined. Although inhibition of RBC AChE was also observed by the inhalation route, the POD for inhalation is derived from portal of entry effects (histopathological lesions of the nasal cavity and the larynx) and therefore, the inhalation exposure estimates should not be combined with the dermal and oral routes.

### 4.6.4 Cancer Classification and Risk Assessment Recommendation

In accordance with the EPA *Proposed Guidelines for Carcinogen Risk Assessment* (July 1999), the Cancer Assessment Review Committee (CARC) classified malathion as "suggestive evidence of carcinogenicity but not sufficient to assess human carcinogenic potential" by all routes of exposure (TXR# 014145, 4/28/2000). Although the cancer classification was based on the agency's 1999 Proposed Guidelines for Carcinogen Risk Assessment, the descriptor (*i.e.,* suggestive evidence of carcinogenicity) is identical to the description of the cancer classification scheme (*i.e*., suggestive evidence of carcinogenic potential) put forth in the agency's 2005 Final Guidelines for Carcinogen Risk Assessment. Additionally, no new carcinogenicity studies in laboratory animals have been submitted to the agency since the 2000 evaluation by the CARC. Furthermore, in 2014 and 2016, OPP conducted a complete review of the available epidemiological data on malathion (D423155 and D426077, see section 4.4.2). Based on the weight of the evidence consideration of the available epidemiological and animal carcinogenicity data, HED concludes that the epidemiological studies will not likely impact the cancer risk assessment for malathion. As such, a reevaluation by the CARC is not warranted at this time.

The classification for malathion as "suggestive evidence of carcinogenicity" was based on the following factors: (i) liver tumors in male and female B6C3F1 mice and in female Fischer 344 rats were seen only at excessive doses; (ii) there are a few rare tumors (oral palate mucosa - female, and nasal respiratory epithelium - male and female) seen in Fischer 344 rats. With the exception of one nasal and one oral tumor in female rats, all other tumor types were determined to occur at excessive doses or were unrelated to treatment with malathion since these tumors cannot be distinguished as either treatment related or due to random occurrence; (iii) the evidence for mutagenicity is not supportive of a mutagenic concern in carcinogenicity; and (iv) malaoxon, a structurally related chemical, is not carcinogenic in male or female Fischer 344 rats

and B6C3F1 mice. The tumors observed in the studies were seen at doses almost 100 times higher than the PODs selected for risk assessment. The Agency has determined that quantification of risk using a non-linear approach (*i.e.,* the chronic reference dose) will adequately protect for all chronic toxicity, including carcinogenicity, likely to result from exposure to malathion.

### 4.6.5 Summary of Points of Departure and Toxicity Endpoints Used in Human Risk Assessment

**Table 4.6.5.1. Summary of Toxicological Doses and Endpoints for Malathion in Dietary and Non-Occupational Human Health Risk Assessments.**

| Exposure Scenario | Point of Departure (POD) | Uncertainty/FQPA Safety Factors | RfD, PAD, Level of Concern for Risk Assessment | Study and Toxicological Effects |
|---|---|---|---|---|
| Acute Dietary (all populations except adults 50-99 years old) | POD=10 mg/kg/day | $UF_A$ = 10X<br>$UF_H$ = 10X<br>FQPA SF = 10X* | aRfD = 0.1 mg/kg/day<br>aPAD = 0.01 mg/kg/day | CCA Studies (MRID 45566201, 46822201, 47373704)<br>Inhibition of RBC AChE in rat pups (PND 11).<br>$BMDL_{10}$ ranged 10-14 mg/kg/day<br>$BMD_{10}$ ranged 13-18 mg/kg/day |
| Acute Dietary (adults 50-99 years old) | POD=10 mg/kg/day | $UF_A$ = 10X<br>$UF_H$ = 10X<br>FQPA SF = 1X | aRfD = 0.1 mg/kg/day<br>aPAD = 0.1 mg/kg/day | CCA Studies (MRID 45566201, 46822201, 47373704)<br>Inhibition of RBC AChE in rat pups (PND 11).<br>$BMDL_{10}$ ranged 10-14 mg/kg/day<br>$BMD_{10}$ ranged 13-18 mg/kg/day |
| Steady-State Dietary (all populations except adults 50-99 years old) | POD=10 mg/kg/day | $UF_A$ = 10X<br>$UF_H$ = 10X<br>FQPA SF = 10X* | ssRfD = 0.1 mg/kg/day<br>ssPAD = 0.01 mg/kg/day | CCA Studies (MRID 45566201, 46822201, 47373704)<br>Inhibition of RBC AChE in rat pups (PND 11).<br>$BMDL_{10}$ ranged 10-14 mg/kg/day<br>$BMD_{10}$ ranged 13-18 mg/kg/day |
| Steady-State Dietary (adults 50-99 years old) | POD=10 mg/kg/day | $UF_A$ = 10X<br>$UF_H$ = 10X<br>FQPA SF = 1X | ssRfD = 0.1 mg/kg/day<br>ssPAD = 0.1 mg/kg/day | CCA Studies (MRID 45566201, 46822201, 47373704)<br>Inhibition of RBC AChE in rat pups (PND 11).<br>$BMDL_{10}$ ranged 10-14 mg/kg/day<br>$BMD_{10}$ ranged 13-18 mg/kg/day |
| Incidental Oral, Steady-State | POD=10 mg/kg/day | $UF_A$ = 10X<br>$UF_H$ = 10X<br>FQPA SF = 10X* | Residential LOC for MOE = 1000 | CCA Studies (MRID 45566201, 46822201, 47373704)<br>Inhibition of RBC AChE in rat pups (PND 11).<br>$BMDL_{10}$ ranged 10-14 mg/kg/day<br>$BMD_{10}$ ranged 13-18 mg/kg/day |
| Dermal, Steady-State | $BMDL_{10}$ = 80 mg/kg/day | $UF_A$ = 10X<br>$UF_H$ = 10X<br>FQPA SF = 10X* | Residential LOC for MOE = 1000 | 21-day dermal toxicity study in rabbits (MRID 46790501)<br>Inhibition of RBC AChE in adult rabbits.<br>$BMD_{10}$ = 124 mg/kg/day |
| Inhalation, Short (1-30 days) and Intermediate (1-6 months)-Term(All populations) | LOAEL = 0.1 mg/L<br>HEC=0.00941 mg/L<br>HED= 1.25 mg/kg/day | $UF_A$ = 3X<br>$UF_H$ = 10X<br>$UF_L$= 10X<br>FQPA SF = 10X* | Residential LOC for MOE = 3000 | 90-day inhalation toxicity study (MRID 43266601)<br>Histopathological lesions of the nasal cavity and the larynx in respiratory epithelium.<br>Portal-of-Entry LOAEL= 0.1 mg/L (the lowest dose tested) |

| Table 4.6.5.1. Summary of Toxicological Doses and Endpoints for Malathion in Dietary and Non-Occupational Human Health Risk Assessments. | | | | |
|---|---|---|---|---|
| **Exposure Scenario** | **Point of Departure (POD)** | **Uncertainty/FQPA Safety Factors** | **RfD, PAD, Level of Concern for Risk Assessment** | **Study and Toxicological Effects** |
| | Residential handler (adults only): HED=1.25 mg/kg/day<br>Residential post-application outdoor (adults and children): HEC = 0.053 mg/L (52.7 mg/m$^3$)<br>Residential by-stander post-application (adults and children): HEC= 0.00941 mg/L (9.411 mg/m$^3$) | | | |
| Cancer (oral, dermal, inhalation) | Classification: "Suggestive evidence of carcinogenicity, but not sufficient to assess human carcinogenic potential". Quantification of risk using a non-linear approach (i.e. the chronic reference dose) will adequately protect for all chronic toxicity including carcinogenicity. | | | |

Point of Departure (PoD) = A data point or an estimated point that is derived from observed dose-response data and used to mark the beginning of extrapolation to determine risk associated with lower environmentally relevant human exposures. NOAEL = no observed adverse effect level. LOAEL = lowest observed adverse effect level. HEC= Human equivalent concentration. HED = Human equivalent dose. UF = uncertainty factor. $UF_A$ = extrapolation from animal to human (interspecies). $UF_H$ = potential variation in sensitivity among members of the human population (intraspecies). $UF_L$ = extrapolation from LOAEL to NOAEL. FQPA SF = FQPA Safety Factor. PAD = population adjusted dose. RfD = reference dose. RfC = reference concentration. (a = acute. ss = steady state or maximal. AChE inhibition which occurs around 2-3 weeks for OPs and is a specific exposure assessment conducted for OPs instead of the traditional short, intermediate, or chronic assessments. The SS assessment is protective of longer durations of exposure, including chronic).*The 10X FQPA SF is retained for infants, children, youth, and women of childbearing age for all exposure scenarios due to uncertainty in the human dose-response relationship for neurodevelopmental effects (see Section 4.4.1). This includes all exposure scenarios, except the dietary exposure scenarios for the population subgroup adults 50-99 for which the FQPA SF has been reduced to 1X. MOE = margin of exposure. LOC = level of concern. N/A = not applicable.

| Table 4.6.5.2 Summary of Toxicological Doses and Endpoints for Malathion for Use in Occupational Human Health Risk Assessments | | | | |
|---|---|---|---|---|
| **Exposure/ Scenario** | **Point of Departure** | **Uncertainty Factors** | **Level of Concern for Risk Assessment** | **Study and Toxicological Effects** |
| Dermal, Steady-State | $BMDL_{10}$ = 80 mg/kg/day | $UF_A$ = 10X<br>$UF_H$ = 10X<br>$UF_{DB}$=10X | Occupational LOC for MOE = 1000 | 21-day dermal toxicity study in rabbits (MRID 46790501)<br>Inhibition of RBC AChE in adult rabbits.<br>$BMD_{10}$ = 124 mg/kg/day |
| Inhalation, Short (1-30 days) and Intermediate (1-6 months)-Term | LOAEL = 0.1 mg/L<br>HED= 3.74 mg/kg/day<br>HEC= 0.04 mg/L | $UF_A$=3X<br>$UF_H$=10X<br>$UF_L$=10X<br>$UF_{DB}$=10X | Occupational LOC for MOE = 3000 | 90-day inhalation toxicity study (MRID 43266601)<br>Histopathology in respiratory epithelium.<br>Portal-of-Entry LOAEL= 0.1 mg/L (The lowest dose tested) |
| Cancer (oral, dermal, inhalation) | Classification: "Suggestive evidence of carcinogenicity, but not sufficient to assess human carcinogenic potential". Quantification of risk using a non-linear approach (i.e. the chronic reference dose) will adequately protect for all chronic toxicity including carcinogenicity. | | | |

Point of Departure (PoD) = A data point or an estimated point that is derived from observed dose-response data and used to mark the beginning of extrapolation to determine risk associated with lower environmentally relevant human exposures. NOAEL = no observed adverse effect level. LOAEL = lowest observed adverse effect level. HED = Human equivalent dose. Steady state (SS)= maximal AChE inhibition which occurs around 2-3 weeks for OPs and is a specific exposure assessment conducted for OPs instead of the traditional short, intermediate, or chronic assessments. The SS assessment is protective of longer durations including chronic. UF = uncertainty factor. $UF_A$ = extrapolation from animal to human (interspecies). $UF_H$ = potential variation in sensitivity among members of the human population (intraspecies). $UF_L$= extrapolation from LOAEL to NOAEL. $UF_{DB}$ = database uncertainty factor for uncertainty in the human dose-response relationship for neurodevelopmental effects (see Section 4.4.1). MOE = margin of exposure. LOC = level of concern. N/A = not applicable.

## 4.7 Endocrine Disruption

As required by FIFRA and FFDCA, EPA reviews numerous studies to assess potential adverse outcomes from exposure to chemicals. Collectively, these studies include acute, subchronic and chronic toxicity, including assessments of carcinogenicity, neurotoxicity, developmental, reproductive, and general or systemic toxicity. These studies include endpoints which may be

susceptible to endocrine influence, including effects on endocrine target organ histopathology, organ weights, estrus cyclicity, sexual maturation, fertility, pregnancy rates, reproductive loss, and sex ratios in offspring. For ecological hazard assessments, EPA evaluates acute tests and chronic studies that assess growth, developmental and reproductive effects in different taxonomic groups. As part of its most recent reregistration decision for malathion, EPA reviewed these data and selected the most sensitive endpoints for relevant risk assessment scenarios from the existing hazard database. However, as required by FFDCA section 408(p), malathion is subject to the endocrine screening part of the Endocrine Disruptor Screening Program (EDSP).

EPA has developed the EDSP to determine whether certain substances (including pesticide active and other ingredients) may have an effect in humans or wildlife similar to an effect produced by a "naturally occurring estrogen, or other such endocrine effects as the Administrator may designate." The EDSP employs a two-tiered approach to making the statutorily required determinations. Tier 1 consists of a battery of 11 screening assays to identify the potential of a chemical substance to interact with the estrogen, androgen, or thyroid (E, A, or T) hormonal systems. Chemicals that go through Tier 1 screening and are found to have the potential to interact with E, A, or T hormonal systems will proceed to the next stage of the EDSP where EPA will determine which, if any, of the Tier 2 tests are necessary based on the available data. Tier 2 testing is designed to identify any adverse endocrine-related effects caused by the substance, and establish a dose-response relationship between the dose and the E, A, or T effect.

Under FFDCA section 408(p), the Agency must screen all pesticide chemicals. Between October 2009 and February 2010, EPA issued test orders/data call-ins for the first group of 67 chemicals, which contains 58 pesticide active ingredients and 9 inert ingredients. A second list of chemicals identified for EDSP screening was published on June 14, 2013[6] and includes some pesticides scheduled for Registration Review and chemicals found in water. Neither of these lists should be construed as a list of known or likely endocrine disruptors.

Malathion is on List 1 for which EPA has received all the required Tier 1 assay data. The Agency has reviewed all assay data received for the appropriate List 1 chemicals and the conclusions of those reviews are available in the chemical-specific public dockets (see Docket# EPA-HQ-OPP-2009-0317) for malathion. There is no convincing evidence for potential interaction with the estrogen, androgen or thyroid pathway. For further information on the status of the EDSP, the policies and procedures, the lists of chemicals, future lists, the test guidelines and the Tier 1 screening battery, please visit our website.[7]

## 5.0 Dietary Exposure and Risk Assessment

Dietary Exposure Memo: DP428996, 06/07/2016, S. Piper.

## 5.1 Metabolite/Degradate Residue Profile

[6] See http://www.regulations.gov/#!documentDetail;D=EPA-HQ-OPPT-2009-0477-0074 for the final second list of chemicals.
[7] http://www.epa.gov/endo/

### 5.1.1 Summary of Plant and Animal Metabolism Studies

The qualitative nature of the residue in plants is adequately understood. The metabolic pathway for malathion in plants is similar: oxidation of malathion to malaoxon and de-esterification to form mono- and dicarboxylic acids and succinate derivatives. The residues to be regulated in plants are malathion and its oxygen analog, malaoxon.

The qualitative nature of the residues in animals is adequately understood. Based on the request for cancellation of all direct animal treatment uses (see FR vol. 56, No. 52, FRL-3874-4), residues of malathion in livestock commodities represent a Category 3 situation under 40 CFR §180.6(a), i.e., there is no reasonable expectation of malathion residues being transferred from treated feed items to livestock commodities. The current tolerances on livestock commodities should be revoked.

### 5.1.2 Summary of Environmental Degradation

The environmental fate data on malathion indicate that it is relatively mobile and shows little persistence in soil and water. The primary route of dissipation of malathion in surface soils appears to be aerobic metabolism. Aerobic soil metabolism data indicate that half-life values for malathion range from several hours to nearly 11 days. The persistence of malathion is decreased with microbial activity, moisture, and high pH. While malathion exhibits short soil persistence, which reduces the likelihood it will leach to groundwater, its low Kd value, and data from various studies, and groundwater detections in three states (CA, MS, and VA) indicate that malathion does have potential to leach to groundwater. Other important routes of dissipation from soil, suggested by the data, include leaching, plant uptake, and surface runoff.

Limited fate data are available for the degradate malaoxon. However, based on its chemical similarity to malathion, it is expected that malaoxon will have similar fate properties as its parent. Malaoxon is shown to form under dry and microbially inactive environmental conditions, such as on dry soil, concrete, or roofing material, where oxidation can occur.

### 5.1.3 Comparison of Metabolic Pathways

Malathion metabolic pathway is similar in all plants. Further, the metabolic pathway in ruminants, poultry, and rats appears similar. The major residue in both plants and animals is the parent compound, and metabolism in both plants and animals appears to occur via oxidation of malathion to malaoxon and de-esterification to form mono- and dicarboxylic acids and succinate derivatives. Malaoxon, when present, comprises a small portion of the total radioactivity. Rat metabolism studies also showed that when orally administered, malathion is excreted primarily in the urine in the first 24 hours following exposure, with lesser amounts excreted in the feces. Radioactivity did not bioaccumulate in any of the organs/tissues analyzed.

### 5.1.4 Residues of Concern Summary and Rationale

Based on available plant metabolism data, the HED Metabolism Committee (B. Dementi, D178477, 8/8/1992) has determined that the malathion residues of concern in plants consists of malathion and its metabolite malaoxon. The tolerance expression (currently expressed in terms of malathion *per se*) should be revised to include malathion and malaoxon.

| Table 5.1.5 Summary of Metabolites and Degradates to be included in the Risk Assessment and Tolerance Expression | | | |
|---|---|---|---|
| Matrix | | Residues included in Risk Assessment | Residues included in Tolerance Expression |
| Plants | Primary Crop | malathion and malaoxon | malathion and malaoxon |
| | Rotational Crop | malathion and malaoxon | malathion and malaoxon |
| Livestock | Ruminant | 180.6(a)(3) | 180.6(a)(3) |
| | Poultry | 180.6(a)(3) | 180.6(a)(3) |
| Drinking Water | | malathion and malaoxon | Not Applicable |

## 5.2 Food Residue Profile

While late and post-season applications may result in surface residues, malathion is readily taken up and translocated by plants. Oxidation of malathion to form malaoxon occurs in plants, however, malathion is typically found to be the major residue in all plants. Field trial data suggests that malathion and malaoxon residues may be found at detectable levels in foods and processed commodities; however, monitoring data show low number of samples with detectable residues of the parent compound, and malaoxon residues were generally undetectable in most crops except blueberries, strawberries and kale. PDP monitoring data found detectable residue of malathion in strawberries (1485 samples/345 detects), caneberries (1477 samples/73 detects), wheat grain (1361 samples/884 detects), wheat flour (1331 samples/587 detects), celery (1480 samples/300 detects), snap peas (1487 samples/107 detects), kale (802 samples/37 detects), and green onions (744 samples/36 detects). Malaoxon residues were in general undetectable in most crops except strawberries (218 detects; max residue 0.04 ppm), blueberries (9 detects; max residue 0.013 ppm), and kale (3 detects; max residue 0.05 ppm).

***Residue Chemistry Summary:***
The residue chemistry database for malathion is complete. A deficiency cited in 1994 (DP196880; 05/26/1994; R. Perfetti) for limited field rotational crop trials is no longer applicable as malathion is now registered for direct application on almost all rotatable crops.

## 5.3 Water Residue Profile

The estimated drinking water concentrations (EDWCs) for malathion residues in surface water were generated using the Surface Water Concentration Calculator (SWCC) computer model, which is derived from the Pesticide Root Zone Model and Exposure Analysis Modeling System (PRZM/EXAMs) to generate EDWCs. The residue of concern for risk assessment in drinking water is the parent and malaoxon. Malathion exposed to chlorine in drinking water treatment facilities is expected to be rapidly and assumes 100% conversion to malaoxon. A TAF of 22x was applied to take into account conversion to malaoxon.

*EDWCs in Groundwater*

As a screening level assessment for groundwater exposure to malathion, PRZM-GW was run using the Florida avocado application parameters (2 applications of 4.7 lbs a.i./A) to represent the highest possible labeled application rate for the six currently available PRZM-GW scenarios. The Florida citrus PRZM-GW scenario estimated the highest concentrations; however, EDWCs from surface water modeling are at least two orders of magnitude larger than those estimated from this screening level approach for groundwater, no further groundwater estimates were derived.

*Assessment of Agricultural Uses*

Twenty modeled scenarios were chosen to represent a range of malathion agricultural uses with large usage and the geographic area encompassed. In an effort to model uses with highest exposure potential, EFED prepared six 30-year time series files for select malathion uses based on highest 1-in-10-year annual averages. Four of the scenarios were applications for agricultural uses that are modeled using a 25 foot buffer to waterbodies and two scenarios were ULV applications which were modeled with a 50 foot buffer to waterbodies per label restrictions. Parameterizations for these scenarios are presented in Table 5.3 below.

**Table 5.3. Application information for modeled agricultural scenarios based on maximum labeled application rates.**

| SWCC Scenario | Application Method | Application Rate (lbs a.i./ac) | Number of Applications | Application Interval | First Application Date |
|---|---|---|---|---|---|
| Florida Cabbage | Aerial | 1.25 | 6 | 7 | 1-Jan |
| Florida Strawberry | Aerial | 2 | 4 | 7 | 15-Jan; 1-May* |
| Mississippi Cotton | Aerial | 2.5 | 3 | 7 | 1-Jun |
| Mississippi Cotton | Aerial/ULV | 1.22 | 3 | 7 | 1-Jun |
| Washington Cherry | Aerial | 1.75 | 4 | 3 | 1-Jan |
| Washington Cherry | Aerial/ULV | 1.22 | 6 | 7 | 1-Jan |

* 2 applications performed per season; ULV=Ultra Low Volume parameterization

*Drinking Water Estimates for Steady-State Assessment*

For steady state, the daily time series were recalculated using 21-day forward rolling averages. In the 21-day rolling average distributions, the first data point is the average of days 1-21, the second data point is the average of days 2-22, the third data point is the average of days 3-23, etc. The 21-day rolling average continues until the last 20 days of residues of the final distribution year (1990). For these residues, the average was taken only of the remaining days, resulting in residue values that are not true 21-day averages.

## 5.4 Dietary Risk Assessment

Highly refined acute and steady-state dietary exposure and risk assessments for malathion and its metabolite malaoxon were conducted using DEEM-FCID Version 3.16. This model uses 2003-2008 food consumption data from USDA's NHANES/WWEIA. Acute and steady-state assessments were conducted for food only, drinking water only, and for food and drinking water.

### 5.4.1 Overview of Residue Data Used

PDP monitoring data were used for all crops in the dietary risk assessment of malathion when available. If monitoring data were not available for a particular commodity (e.g., horseradish), but were available for a similar commodity (carrots), the available data were translated to the similar crop (HED SOP 99.3; HED SOP 2000.1) with similar use patterns. Field trial data was used for nuts (chestnuts, macadamia nuts, pecan, and walnuts), cotton, dates, figs, guava, spearmint, peppermint, and passion fruit. Only dates, mints, guava and cotton had detectable residues of malaoxon. All residue distribution files (RDFs) were adjusted to account for the malaoxon TAF of 22X.

Malathion is an insecticide that is used outdoors to control a wide variety of insects in agricultural crops, including for use in the Cotton Boll Weevil Eradication Program and for mosquito-borne disease control (adulticide use). While tolerances are established to support the direct application to agricultural crops, there are no tolerances established on any crops for which there is not a direct application for residues of malathion that may result from the adulticide use. While the registrant has petitioned for these tolerances, they have not been formally established. However, for this assessment, the proposed tolerances or the translated residue and/or monitoring data on which they are based, are included in this assessment. The Agency notes that malathion is registered on almost all major crops in terms of acreage and consumption. Amongst the unregistered crops, only bananas, cilantro, and honey were analyzed by PDP for malathion from 2001-2010. For all other unregistered crops, estimated residues were translated from monitoring data on similar crops.

The most recent dietary memo (S. Piper; 06/07/2016; D428996) summarizes the residue inputs (RDFs used, point estimates, processing factors, PCT, etc.), residue data used for each commodity, procedures for combining residues of malathion and malaoxon, and all of the RDF files used for the acute and steady-state assessments.

### 5.4.2 Percent Crop Treated Used in Dietary Assessment

A Screening Level Usage Analysis (SLUA) memo was provided by BEAD (J. Alsadek, 04/01/2015). The acute and steady-state analyses incorporated maximum PCT for the following commodities: alfalfa: <2.5%; apple: <2.5%; apricot: <2.5%; asparagus: 10%; avocado: 5%; barley: 5%; bean, green: <2.5%; blueberries: 40%; broccoli: 5%; Brussel sprouts: 20%; cabbage: 5%; caneberries: 70%; canola: 10%; cantaloupes: 5%; carrots: 20%; cauliflower: 5%; celery: 30%; cherries: 25%; corn: <2.5%; cotton: 20%; cucumbers: 5%; dates: 10%; dry bean/peas: <2.5%; eggplant: 5%; fig: 10%; garlic: 10%; grapefruit: 15%; grapes: <2.5%; lemons: <2.5%; lettuce: 15%; oats: <2.5%; onions 10%; oranges: 20%; peaches: 5%; peanuts: 2.5%; pears: <2.5%; peas, green: 2.5%; pecans: 5%; peppers: 5%; plums/prunes: <2.5%; potatoes: 2.5%; pumpkins: 10%; rice: <2.5%; sorghum: <2.5%; soybeans: <2.5%; spinach: 5%; squash: strawberries: 55%; sugar beets: <2.5%; sugarcane: <2.5%; sunflowers: <2.5%; sweet corn: <2.5%; tangerines: 25%; tomatoes: 5%; walnuts: 15%; watermelons: 5%; and wheat: <2.5%.

### 5.4.3 Acute Dietary Risk Assessment

Acute assessments were conducted for food only, drinking water only, and for food and drinking water to characterize dietary exposure. The food only acute dietary risk estimates are below HED's LOC (<100% of the aPAD) for the U.S. population and all population subgroups at the

99.9th percentile. Malathion dietary exposure for food alone is 27% of the aPAD for the U.S. population, and children 1-2 years old, the most highly exposed population subgroup, is 74% of the aPAD at the 99.9th percentile. The results for all population subgroups (general U.S. population, all infants (<1 year old), children 1-2, children 3-5, children 6-12, youth 13-19, females 13-49, adults 20-49, and adults 50-99 years) for all runs are summarized in Table 5.4.6.1.

For the acute drinking water only runs, six different application scenarios (FL cabbage, FL strawberry, MS cotton, WA cherry, WA cherry ULV and MS cotton ULV) were analyzed. The WA cherry maximum aerial scenario results in the highest estimated drinking water concentration. The WA cherry maximum aerial scenario results in drinking water only dietary estimates are above HED's level of concern (>100 % of the aPAD) at the 99.9th percentile. For drinking water only, the WA cherry scenario results for all infants (<1 year old) is 690% of the aPAD, the highest exposed population subgroup. The results for all application scenarios, including the scenario that resulted in the highest exposure, are summarized below in Table 5.4.6.2. Combined dietary exposure from food and the highest drinking water scenario is 240% of the aPAD for the U.S. population and 690% of the aPAD for all infants (<1 year old), the highest exposed population subgroups. The results for all population subgroups for all runs are summarized in Table 5.4.6.3.

### 5.4.4 Steady-State Dietary Risk Assessment

Steady state assessments were conducted for food only, drinking water only, and for food and drinking water. The food only steady-state estimates are below HED's LOC (<100% of the ssPAD) for the U.S. population and all population subgroups at the 99.9th percentile. The U.S. population utilized 24% of the ssPAD and children 1-2 years old, the most highly exposed population subgroup, utilized 48% of the ssPAD. The results for all population subgroups for all runs are summarized in Table 5.4.6.4.

For the steady state drinking water only runs, six different application scenarios (FL cabbage, FL strawberry, MS cotton, WA cherry, WA cherry ULV and MS cotton ULV) were analyzed. The WA cherry maximum aerial scenario results in the highest estimated drinking water concentration. The WA cherry maximum aerial scenario results in drinking water only dietary estimates are above HED's level of concern (>100 % of the ssPAD) at the 99.9th percentile. For drinking water only, the WA cherry scenario results for all infants (<1 year old) is 480% of the aPAD, the highest exposed population subgroup. The results for all application scenarios, including the scenario that resulted in the highest exposure, are summarized below in Table 5.4.6.5.

The food and drinking water steady-state analyses were conducted using the water scenario that resulted in the highest estimated drinking water risks (WA cherry scenario). Combining the food exposure with the WA cherry maximum aerial scenario results in dietary (food and water) estimates that are above HED's level of concern (>100 % of the ssPAD). Combined dietary exposure from food and drinking water is 170% of the ssPAD for the U.S. population and 470% of the ssPAD all infants (<1 year old), the most highly exposed population subgroup. The results are provided below in Table 5.4.6.6.

### 5.4.5 Cancer Dietary Risk Assessment

Malathion is classified as "suggestive evidence of carcinogenicity, but not sufficient to assess human carcinogenic potential." Therefore, a quantitative cancer dietary exposure analysis is not appropriate.

### 5.4.6. Dietary Assessment Summary Tables

**Table 5.4.6.1. Summary of Acute Dietary (Food Only) Exposure and Risk for Malathion**

| Population Subgroup | aPAD (mkd) | 95th Percentile | | 99th Percentile | | **99.9th Percentile** | |
|---|---|---|---|---|---|---|---|
| | | Exposure (mkd) | % aPAD | Exposure (mkd) | % aPAD | Exposure (mkd) | % aPAD |
| General U.S. Population | 0.01 | 0.000328 | 3 | 0.000683 | 7 | 0.002701 | 27 |
| All Infants (<1 year old) | 0.01 | 0.000437 | 4 | 0.000679 | 7 | 0.003694 | 37 |
| **Children 1-2 years old** | 0.01 | 0.000661 | 7 | 0.001520 | 15 | **0.007434** | **74** |
| Children 3-5 years old | 0.01 | 0.000527 | 5 | 0.001170 | 12 | 0.004276 | 43 |
| Children 6-12 years old | 0.01 | 0.000344 | 3 | 0.000815 | 8 | 0.004107 | 41 |
| Youth 13-19 years old | 0.01 | 0.000203 | 2 | 0.000455 | 5 | 0.002361 | 24 |
| Adults 20-49 years old | 0.01 | 0.000274 | 3 | 0.000588 | 6 | 0.002899 | 29 |
| Adults 50-99 years old | 0.1 | 0.000252 | <1 | 0.000597 | <1 | 0.001642 | 2 |
| Females 13-49 years old | 0.01 | 0.000211 | 2 | 0.000473 | 5 | 0.003144 | 31 |

mkd = mg/kg/day. aPAD= acute population adjusted dose; Highest exposure at the 99.9th percentile is in bold font

**Table 5.4.6.2. Summary of Acute Assessment Results for Maximum Application Rate of Drinking Water Only**

| Drinking Water Scenario | Acute WATER ONLY (All Infants <1 year old) | | | | Acute WATER ONLY (Children 1-2 years old) | | | |
|---|---|---|---|---|---|---|---|---|
| | 95th | | 99.9th | | 95th | | 99.9th | |
| | Exposure (mkd) | % aPAD | Exposure (mkd) | % aPAD | Exposure (mkd) | % aPAD | Exposure (mkd) | % aPAD |
| FL Cabbage | 0.002846 | 28 | 0.024218 | 240 | 0.0001707 | 17 | 0.013005 | 130 |
| FL Strawberry | 0.002205 | 22 | 0.034855 | 350 | 0.001458 | 15 | 0.018610 | 190 |
| MS Cotton | 0.000157 | 2 | 0.015996 | 160 | 0.000231 | 2 | 0.008550 | 86 |
| **WA Cherry** | **0.001354** | **14** | **0.068773** | **690** | **0.001564** | **16** | **0.036267** | **360** |
| WA Cherry ULV | 0.000010 | <1 | 0.000066 | <1 | 0.000006 | <1 | 0.000036 | <1 |
| MS Cotton ULV | 0.000001 | <1 | 0.000046 | <1 | 0.000001 | <1 | 0.000024 | <1 |

mkd = mg/kg/day. aPAD= acute population adjusted dose; Highest exposure at the 99.9th percentile is in bold font

**Table 5.4.6.3. Summary of Acute Dietary (Food and WA Cherry Drinking Water) Exposure and Risk for Malathion**

| Population Subgroup | aPAD (mkd) | 95th Percentile | | 99th Percentile | | **99.9th Percentile** | |
|---|---|---|---|---|---|---|---|
| | | Exposure (mkd) | % aPAD | Exposure (mkd) | % aPAD | Exposure (mkd) | % aPAD |
| General U.S. Population | 0.01 | 0.001462 | 15 | 0.008444 | 84 | 0.024399 | 240 |
| **All Infants (<1 year old)** | 0.01 | 0.001832 | 18 | 0.025723 | 260 | **0.068903** | **690** |
| Children 1-2 years old | 0.01 | 0.002393 | 24 | 0.012608 | 130 | 0.037478 | 380 |
| Children 3-5 years old | 0.01 | 0.001901 | 19 | 0.010497 | 110 | 0.028678 | 290 |
| Children 6-12 years old | 0.01 | 0.001394 | 14 | 0.007678 | 77 | 0.022784 | 230 |
| Youth 13-19 years old | 0.01 | 0.000968 | 10 | 0.006321 | 63 | 0.019591 | 200 |
| Adults 20-49 years old | 0.01 | 0.001437 | 14 | 0.008573 | 86 | 0.023019 | 230 |
| Adults 50-99 years old | 0.1 | 0.001561 | 2 | 0.008142 | 8 | 0.021052 | 21 |
| Females 13-49 years old | 0.01 | 0.001369 | 14 | 0.008596 | 86 | 0.023309 | 230 |

mkd = mg/kg/day. aPAD= acute population adjusted dose; Highest exposure at the 99.9th percentile is in bold font

| Table 5.4.6.4. Summary of Steady State Dietary (Food Only) Exposure and Risk for Malathion | | | | | | | |
|---|---|---|---|---|---|---|---|
| Population Subgroup | ssPAD (mkd) | 95th Percentile | | 99th Percentile | | **99.9th Percentile** | |
| | | Exposure (mkd) | % ssPAD | Exposure (mkd) | % ssPAD | Exposure (mkd) | % ssPAD |
| General U.S. Population | 0.01 | 0.000313 | 3 | 0.000607 | 6 | 0.002413 | 24 |
| All Infants (<1 year old) | 0.01 | 0.000430 | 4 | 0.000676 | 7 | 0.002251 | 23 |
| **Children 1-2 years old** | 0.01 | 0.000646 | 6 | 0.001399 | 14 | **0.004761** | **48** |
| Children 3-5 years old | 0.01 | 0.000497 | 5 | 0.000936 | 9 | 0.002872 | 29 |
| Children 6-12 years old | 0.01 | 0.000329 | 3 | 0.000713 | 7 | 0.003251 | 33 |
| Youth 13-19 years old | 0.01 | 0.000188 | 2 | 0.000420 | 4 | 0.001379 | 14 |
| Adults 20-49 years old | 0.01 | 0.000254 | 3 | 0.000519 | 5 | 0.002814 | 28 |
| Adults 50-99 years old | 0.1 | 0.000239 | <1 | 0.000516 | <1 | 0.001365 | 1 |
| Females 13-49 years old | 0.01 | 0.000199 | 2 | 0.000428 | 4 | 0.002646 | 26 |

mkd = mg/kg/day. ssPAD = steady-state population-adjusted dose. Highest exposure at the 99.9th percentile is in bold font

**Table 5.4.6.5. Summary of Steady State Assessment Results for Maximum Application Rate of Drinking Water Only**

| Drinking Water Scenario | Steady State WATER ONLY (All Infants <1 year old) | | | | Steady State WATER ONLY (Children 1-2 years old) | | | |
|---|---|---|---|---|---|---|---|---|
| | 95th | | 99.9th | | 95th | | 99.9th | |
| | Exposure (mkd) | % ssPAD | Exposure (mkd) | % ssPAD | Exposure (mkd) | % ssPAD | Exposure (mkd) | % ssPAD |
| FL Cabbage | 0.003495 | 35 | 0.016537 | 170 | 0.001786 | 18 | 0.008952 | 90 |
| FL Strawberry | 0.003025 | 30 | 0.019562 | 200 | 0.001554 | 16 | 0.009984 | 100 |
| MS Cotton | 0.000750 | 8 | 0.011172 | 110 | 0.000512 | 5 | 0.005532 | 55 |
| **WA Cherry** | **0.003595** | **36** | **0.047901** | **480** | **0.002779** | **28** | **0.024247** | **240** |
| WA Cherry ULV | 0.000011 | <1 | 0.000049 | <1 | 0.000006 | <1 | 0.000027 | <1 |
| MS Cotton ULV | 0.000001 | <1 | 0.000044 | <1 | 0.000022 | <1 | 0.004829 | <1 |

mkd = mg/kg/day. ssPAD= acute population adjusted dose; Highest exposure at the 99.9th percentile is in bold font

| Table 5.4.6.6. Summary of Steady State Dietary (Food and WA Cherry Drinking Water) Exposure and Risk for Malathion | | | | | | | |
|---|---|---|---|---|---|---|---|
| Population Subgroup | ssPAD (mkd) | 95th Percentile | | 99th Percentile | | **99.9th Percentile** | |
| | | Exposure (mkd) | % ssPAD | Exposure (mkd) | % ssPAD | Exposure (mkd) | % ssPAD |
| General U.S. Population | 0.01 | 0.002147 | 21 | 0.006825 | 68 | 0.016610 | 170 |
| **All Infants (<1 year old)** | 0.01 | 0.003910 | 39 | 0.021553 | 220 | **0.047290** | **470** |
| Children 1-2 years old | 0.01 | 0.003291 | 33 | 0.010527 | 110 | 0.024835 | 250 |
| Children 3-5 years old | 0.01 | 0.002765 | 28 | 0.008419 | 84 | 0.019446 | 190 |
| Children 6-12 years old | 0.01 | 0.001986 | 20 | 0.006118 | 61 | 0.014652 | 150 |
| Youth 13-19 years old | 0.01 | 0.001450 | 15 | 0.005283 | 53 | 0.012409 | 120 |
| Adults 20-49 years old | 0.01 | 0.002180 | 22 | 0.006866 | 69 | 0.015436 | 150 |
| Adults 50-99 years old | 0.1 | 0.002210 | 2 | 0.006460 | 6 | 0.014391 | 14 |
| Females 13-49 years old | 0.01 | 0.002110 | 21 | 0.007007 | 70 | 0.015356 | 150 |

mkd = mg/kg/day. ssPAD = steady-state population-adjusted dose. Highest exposure at the 99.9th percentile is in bold font

## 6.0 Residential (Non-Occupational) Exposure/Risk Characterization

Occupational and Residential Exposure Memo: DP431434, 06/09/2016, S. Shelat.

The registered residential uses have been assessed as part of Registration Review. There have been no new uses registered since the last residential risk assessment (J. Arthur, D330678, 7/6/2006). The existing residential uses have been reassessed in this document to reflect updates to HED's 2012 Residential SOPs[8], changes for body weight assumptions, along with changes to the toxicological profile for assessing malathion.

Malathion is currently registered for use in outdoor residential ornamentals, vegetable gardens, building perimeter treatment, and outdoor areas for mosquito and flying insect applications. Malathion is not a restricted use pesticide and may result in potential exposure to both handlers (adults) and in post-application scenarios (adults and children) for those uses. Malathion is also registered for pick-your-own farm applications and, therefore, may result in post-application exposure for individuals entering into previously treated areas.

For adults, when an endpoint is not sex-specific (i.e., the endpoints are based on developmental or fetal effects) a body weight of 80 kg is typically used in risk assessment; however, in this case, a female-specific body weight of 69 kg was used. While the endpoints of concern, RBC AChE inhibition and inhalation portal of entry effects, are not sex-specific, the female-specific body weight was used to protect for pregnant women due to uncertainty in the human dose-response relationship for neurodevelopmental effects (See Section 4.4).

## 6.1 Residential Handler Exposure

HED uses the term "handlers" to describe those individuals who are involved in the pesticide application process. HED believes that there are distinct tasks related to applications and that exposures can vary depending on the specifics of each task. Residential handlers are addressed somewhat differently by HED as homeowners are assumed to complete all elements of an application without use of any protective equipment.

The quantitative exposure/risk assessment developed for residential handlers is based on the following scenarios for gardens and trees and outdoor perimeter/spot applications:

- Manually-pressurized handwand;
- Hose-end sprayer;
- Backpack
- Sprinkler can; and
- Outdoor handheld fogger/mister (using surrogate unit exposure data from RTU aerosol can).

Some of the registered malathion product labels with residential use sites (e.g., home ornamental and vegetable gardens as well as spot and perimeter outdoor uses for insect and mosquito control) require that handlers wear specific clothing (e.g., long sleeve shirt/long pants) and/or use personal protective equipment (PPE). Therefore, HED has made the assumption that these products are not for homeowner use, and has not conducted a quantitative residential handler

[8] Available: http://www2.epa.gov/pesticide-science-and-assessing-pesticide-risks/standard-operating-procedure-residential-exposure

assessment. The labels that were identified by the registrant to be homeowner uses but were reviewed to show PPE are as follows: EPA Reg Nos 45385-43; 47000-107; 28293-123; 33955-394; 4-412; 10088-56. A number of labels were assessed as part of the residential handler assessment which did not include recommendations or requirements for PPE (e.g., 4-99; 46515-19; 7401-10; 829-175; 289-739) as well as consideration of some uses that were reviewed as part of the 2006 RED.

Summary of Residential Handler Non-Cancer Exposure and Risk Estimates

The residential handler exposure and risk estimates indicate that the inhalation MOEs are not of concern to HED (i.e., MOE $\geq$ 3000) for most scenarios with the exception of the following scenarios: manually-pressurized handwand application to outdoor perimeter areas of households (MOE = 1,900); hose-end sprayer application to standing water/mosquito areas (MOE = 1,500), backpack application for outdoor building perimeter and mosquitos (MOE = 250 and 720), and for mosquito control misting/fogger applications (MOEs = 240 and 48). Dermal exposure and risk estimates, however, are of concern (i.e., MOEs < 1000) for most scenarios. The risk estimates are presented below in Table 6.1.1.

| Table 6.1.1. Residential Handler Non-cancer Exposure and Risk Estimates for Malathion. | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| Exposure Scenario | Target Crops | Dermal Unit Exposure (mg/lb ai) | Inhalation Unit Exposure (mg/lb ai) | Maximum Application Rate[1] | Area Treated or Amount Handled Daily[2] | Dermal | | Inhalation | |
| | | | | | | Dose (mg/kg/day)[3] | MOE[4] LOC=1000 | Dose (mg/kg/day)[5] | MOE[6] LOC=3000 |
| Mixer/Loader/Applicator | | | | | | | | | |
| Manually-pressurized handwand (liquids) | Homeowner Ornamentals | 63 | 0.018 | 0.023 lbs ai/gallon | 5 gallons | 0.11 | **760** | 0.00003 | 42,000 |
| | Homeowner Outdoor Building Perimeter Treatments | | | 0.5 lbs ai/gallon | 5 gallons | 2.3 | **35** | 0.00065 | **1,900** |
| | Homeowner Vegetables/ Small Fruits- Low rates | | | 0.0000256 lb ai/$ft^2$ | 1200 $ft^2$ | 0.028 | 2900 | 0.000008 | 160,000 |
| | Homeowner Vegetables/ Small Fruits- Medium rates | | | 0.0000512 lb ai/$ft^2$ | | 0.056 | 1400 | 0.000016 | 78,000 |
| | Homeowner Vegetables/ Small Fruits- High rates | | | 0.0001 lb ai/$ft^2$ | | 0.11 | **730** | 0.000031 | 40,000 |
| Hose-end Sprayer (liquids) | Homeowner Vegetables/ Small Fruits- Low rates | 58 | 0.0014 | 0.0000256 lb ai/$ft^2$ | 1200 $ft^2$ | 0.026 | 3100 | 0.00000062 | 2,000,000 |
| | Homeowner Vegetables/ Small Fruits- Medium rates | | | 0.0000512 lb ai/$ft^2$ | | 0.052 | 1500 | 0.0000012 | 1,000,000 |
| | Homeowner Vegetables/ Small Fruits- High rates | | | 0.0001 lb ai/$ft^2$ | | 0.1 | **790** | 0.0000024 | 510,000 |
| | Homeowner Ornamentals | | | 0.023 lbs ai/gallon | 11 gallons | 0.21 | **380** | 0.0000051 | 240,000 |
| | Homeowner Outdoor Building | | | 0.5 lbs ai/gallon | 11 gallons | 4.6 | **17** | 0.00011 | 11,000 |

**Table 6.1.1. Residential Handler Non-cancer Exposure and Risk Estimates for Malathion.**

| Exposure Scenario | Target Crops | Dermal Unit Exposure (mg/lb ai) | Inhalation Unit Exposure (mg/lb ai) | Maximum Application Rate[1] | Area Treated or Amount Handled Daily[2] | Dermal | | Inhalation | |
|---|---|---|---|---|---|---|---|---|---|
| | | | | | | Dose (mg/kg/day)[3] | MOE[4] LOC=1000 | Dose (mg/kg/day)[5] | MOE[6] LOC=3000 |
| | Perimeter Treatments | | | | | | | | |
| Backpack (liquids) | Homeowner Vegetables/ Small Fruits- Low rates | 130 | 0.14 | 0.0000256 lb ai/ft$^2$ | 1200 ft$^2$ | 0.058 | 1400 | 0.000062 | 20,000 |
| | Homeowner Vegetables/ Small Fruits- Medium rates | | | 0.0000512 lb ai/ft$^2$ | | 0.12 | **690** | 0.00012 | 10,000 |
| | Homeowner Vegetables/ Small Fruits- High rates | | | 0.0001 lb ai/ft$^2$ | | 0.23 | **350** | 0.00024 | 5,100 |
| | Homeowner Ornamentals | | | 0.023 lbs ai/gallon | 5 gallons | 0.22 | **370** | 0.00023 | 5,400 |
| | Homeowner Outdoor Building Perimeter Treatments | | | 0.5 lbs ai/gallon | 5 gallons | 4.7 | **17** | 0.0051 | **250** |
| Sprinkler can | Homeowner Vegetables/ Small Fruits- Low rates | 58 | 0.0014 | 0.0000256 lb ai/ft$^2$ | 1200 ft$^2$ | 0.026 | 3100 | 0.00000062 | 2,000,000 |
| | Homeowner Vegetables/ Small Fruits- Medium rates | | | 0.0000512 lb ai/ft$^2$ | | 0.052 | 1500 | 0.0000012 | 1,000,000 |
| | Homeowner Vegetables/ Small Fruits- High rates | | | 0.0001 lb ai/ft$^2$ | | 0.1 | **790** | 0.0000024 | 510,000 |
| | Homeowner Ornamentals | | | 0.023 lbs ai/gallon | 5 gallons | 0.097 | **830** | 0.0000023 | 540,000 |

**Table 6.1.1. Residential Handler Non-cancer Exposure and Risk Estimates for Malathion.**

| Exposure Scenario | Target Crops | Dermal Unit Exposure (mg/lb ai) | Inhalation Unit Exposure (mg/lb ai) | Maximum Application Rate[1] | Area Treated or Amount Handled Daily[2] | Dermal | | Inhalation | |
|---|---|---|---|---|---|---|---|---|---|
| | | | | | | Dose (mg/kg/day)[3] | MOE[4] LOC=1000 | Dose (mg/kg/day)[5] | MOE[6] LOC=3000 |
| Hose-end Sprayer | Standing Water/Mosquito | 13.4 | 0.022 | 5.1 lbs ai/acre | 0.5 acres | 0.5 | **160** | 0.00081 | **1,500** |
| Manually-pressurized handwand | | 63 | 0.018 | 0.17 lbs ai/gallon | 5 gallons | 0.78 | **100** | 0.00022 | 5,600 |
| Backpack | | 130 | 0.14 | 0.17 lbs ai/gallon | 5 gallons | 1.6 | **50** | 0.0017 | **720** |
| Outdoor Fogger/ Misting System | Outdoor Yard Mosquito Control [7] | 370 | 3.0 | 0.12 lbs ai/day | 1 gallon | 0.64 | **120** | 0.0052 | **240** |
| | | | | | 5 gallons | 3.2 | **25** | 0.026 | **48** |

1 Based on registered labels (Section 3.3 and Appendix C). Malathion is registered on a variety of homeowner fruit and vegetable plants. The target site and rate combinations can be found in Appendix C.

2 Based on HED's 2012 Residential SOPs (http://www2.epa.gov/pesticide-science-and-assessing-pesticide-risks/standard-operating-procedure-residential-exposure).; For outdoor mosquito control, the 1 gallon and 5 gallon assumption are used to represent the range in volume of publically available equipment for fogger and misting handheld applications.

3 Dermal Dose = Dermal Unit Exposure (mg/lb ai) × Application Rate (lb ai/acre or gal) × Area Treated or Amount Handled (A/day or gallons/day) × Dermal Absorption Factor (100 %) ÷ Body Weight (69kg).

4 Dermal MOE = Dermal NOAEL (80mg/kg/day) ÷ Dermal Dose (mg/kg/day).

5 Inhalation Dose = Inhalation Unit Exposure (mg/lb ai) × Application Rate (lb ai/acre or gal) × Area Treated or Amount Handled (A/day or gallons/day) ÷ BW (69kg).

6 Inhalation MOE = Inhalation HED (1.25mg/kg/day) ÷ Inhalation Dose (mg/kg/day).

7 Based on registered label (EPA Reg No. 10088-56). The aerosol can unit exposures were used as a surrogate application scenario to represent the adult mosquito control use which states to apply the spray mixture as a fine mist or fog to lower outside foundations of homes or shrubs.

## 6.2 Post-Application Exposure

There is the potential for post-application exposure for individuals exposed as a result of being in an environment that has been previously treated with malathion. Malathion can be used in areas frequented by the general population including residential gardens, pick-your-own farm settings, and as a result of aerial and ground-based ULV mosquito adulticide applications made directly in residential areas. The quantitative exposure and risk assessment for residential post-application exposures is based on the following scenarios from the registered uses:

- Adult post-application dermal exposure from gardens treated with malathion.
- Children (6<11) years old post-application dermal exposure from gardens treated with malathion.
- Adult post-application dermal exposure from pick-your-own farms treated with malathion.
- Children (6<11) years old post-application dermal exposure from pick-your-own farms treated with malathion.
- Adult post-application dermal exposure from contact with turf following the deposition of malathion residues from aerial and ground public health mosquito adulticide application.
- Adult post-application inhalation exposure from airborne malathion following aerial and ground public health mosquito adulticide application.
- Children 1 to < 2 years old post-application dermal exposure from contact with turf following the deposition of malathion residues from aerial and ground public health mosquito adulticide application.
- Children 1 to < 2 years old post-application incidental oral (hand-to-mouth) exposure from contact with turf following the deposition of malathion residues from aerial and ground public health mosquito adulticide application.
- Children 1 to < 2 years old post-application incidental oral (object-to-mouth) exposure from contact with toys containing residues from turf following the deposition of malathion residues from public health mosquito adulticide application.
- Children 1 to < 2 years old post-application inhalation exposure from airborne malathion following public health mosquito adulticide application.

A post-application assessment was not conducted for the perimeter and spot lawn applications of malathion. These include the application to edging use (e.g., along fence rows), a foundation perimeter treatment (e.g., 3 foot band around the perimeter of a house), or a specific spot treatment (e.g., ant mounds). Additionally, post-application assessment of the outdoor residential mosquito control application was not conducted because the direct residential application is directed towards the lower outside foundations of homes or as a spot treatment for yards and lawns. These types of uses can result in residues on turf but residential exposure is expected to be negligible.

The lifestages selected for each post-application scenario are based on an analysis provided as an Appendix in the 2012 Residential SOPs[9]. While not the only lifestage potentially exposed for these post-application scenarios, the lifestage that is included in the quantitative assessment is health protective for the exposures and risk estimates for any other potentially exposed lifestage.

For adults, when an endpoint is not sex-specific (i.e., the endpoints are based on developmental or fetal effects) a body weight of 80 kg is typically used in risk assessment; however, in this case, a female-specific body weight of 69 kg was used. While the endpoints of concern, RBC AChE inhibition and inhalation portal of entry effects, are not sex-specific, the female-specific body weight was used to protect for pregnant women due to uncertainty in the human dose-response relationship for neurodevelopmental effects (See Section 4.4.1).

*DFR Data:* A total of six chemical-specific DFR data sets have been submitted for malathion on the following crops: grapes (MRID 450059-10), wine grapes (MRID 454919-01), apples (MRID 451382-02), summer squash (MRID 454919-02), blackberries (MRID 451382-01), and nursery stock (MRID 454695-01). All six studies have been reviewed by HED (see Appendix E) and found to be acceptable for risk assessment. HED also notes that the studies did not discuss measurements for malaoxon. Malathion is registered on a variety of plants (i.e., vegetable, fruit, and ornamentals) grown in residential garden settings. For the post-application residential scenarios, HED has used an average DFR value from the malathion chemical-specific studies to represent the post-application exposures and risk estimates. EPA ran new DFR regressions for the post-application risk assessment in order to assess potential risk from the oxon product as well as the parent malathion. The dissipation curve was based on malathion DFRs plus estimated malaoxon residue. The oxon was estimated to be 5% of the parent residue. A toxicity factor of 22 was also applied to malaoxon residue. A full discussion of the DFR data can be found in Appendix E and D431434.

*TTR Data:* TTR data (*A Transferrable Residue Study - Malathion Residues in Turf*) is available for malathion. A HED review of MRID 439450-01 was completed in 2000 (J. Arthur, D240569, 1/10/2000) and the updated regression analysis was completed as part of this assessment. TTR residues have been used in the post-application exposure assessment following the deposition of malathion residues from public health mosquito adulticide application.

The transferable residue study on turf was conducted with the pesticide malathion formulated as the end use product Malathion 57EC. Four geographic sites were included in this study to represent the different use areas in the United States. EPA ran new TTR regressions for the post-application risk assessment in order to assess potential risk from the oxon product as well as the malathion. The dissipation curve was based on malathion TTRs plus estimated malaoxon residue. The oxon was estimated to be 5% of the parent residue. A toxicity factor of 22 was also applied to malaoxon residue. A full discussion of the TTR data can be found in Appendix E and D431434.

[9] Available: http://www2.epa.gov/pesticide-science-and-assessing-pesticide-risks/standard-operating-procedures-residential-pesticide

Public Health Mosquito Adulticide Use

The post-application exposure potential from public health mosquito adulticide applications has been considered for both ground based truck foggers and also from aerial applications. For assessment of the mosquito adulticide use, the algorithms and inputs presented in the 2012 Residential SOPs, Lawns/Turf section were used, coupled with the available TTR data described above. The deposition of malathion from these applications are not based on the application rate alone, but also using the AgDISP (v8.2.6) model or empirical data to determine how much pesticide is deposited on residential lawns as a result of mosquito adulticide treatments at the maximum application rates for each. The TTR data are then used to determine the fraction of the total residue deposited following the mosquitocide application which can result in exposures to impacted individuals. Inhalation exposures are estimated using AgDRIFT for aerial applications, and a recently developed, Well Mixed Box (WMB) Model approach based on the Residential SOPs for outdoor foggers.

The inputs used in the *AgDISP* calculations are presented in Appendix F. Because the resulting fraction of deposition and air concentration are determined by the application parameters, HED has also provided a sensitivity analysis of the application parameters that may differ between different applications. The figures below, which represent a mosquitocide release at a minimum of 100 feet and 1 mile per hour wind speed, are based on registered mosquitocide uses (e.g., EPA Reg 67760-34).

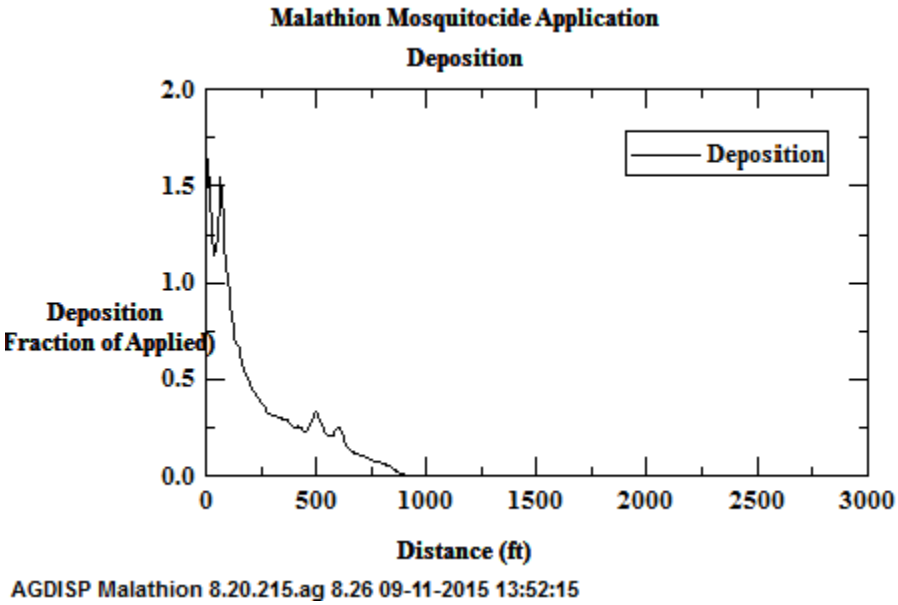



Figure 6.2.1. Estimated malathion deposition downwind from the field edge from aerial treatment of mosquito adulticide at release height of 100 feet. Where the fraction of application rate for deposition was determined to be greater than 1, the maximum fraction of 1 will be used for the disposition value.

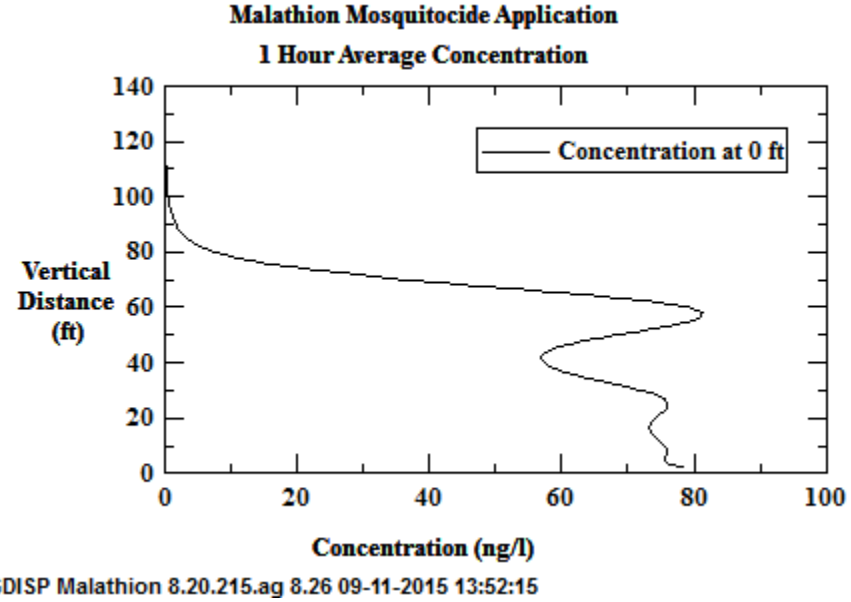



Figure 6.2.2. Estimated malathion air concentration at the field edge from aerial treatment of mosquito adulticide at a release height of 100 feet. 0.75 ng/l = 0.075mg/m$^3$ is the concentration at breathing height for adults and children.

Table 6.2.1 below provides a sensitivity analysis for application parameters that may differ from the minimum label requirements.

| **Table 6.2.1. Sensitivity Analysis for the Mosquitocide ULV Application Parameters** | | |
|---|---|---|
| **Droplet Size** | **Fraction of Application Rate for Deposition (unitless)** | **Air concentration at breathing height (mg/m3)** |
| **Current Label Parameters[1]** | | |
| **60 um** | >1 (1.65)[2] | 0.075 |
| **Refinements** | | |
| **300 feet release height and various droplet sizes[3]** | | |
| **60 um** | 0.41 | 0.012 |
| **50 um** | 0.26 | 0.01 |
| **45 um** | 0.18 | 0.008 |

1. The ULV mosquitocide labels require applications to occur when the wind speed is greater than or equal to 1 mph and not to apply by fixed wing aircraft at a height less than 100 feet or by helicopter at a height less than 75 feet unless specifically approved by the state or tribe based on public health needs.
2. Where the fraction of application rate for deposition was determined to be greater than 1, the maximum fraction of 1 will be used for the exposure calculations.
3. The *AgDISP* output graphs that represent the refinements are provided in Appendix F.

Summary of Residential Post-application Non-Cancer Exposure and Risk Estimates

The residential post-application exposure and risk estimates indicate that there are numerous children and adult residential exposure scenarios that are of concern for all post-application scenarios (i.e., MOEs < 3000 for inhalation and MOEs < 1000 for incidental oral and dermal). The risk estimates are presented below in Table 6.2.2.

**Table 6.2.2. Residential Post-application Non-cancer Exposure and Risk Estimates for Malathion and Malaoxon**

| Lifestage | Post-application Exposure Scenario | | Application Rate[1] | Dose (mg/kg/day)[2] | MOEs[3] | Combined Routes[4] | Combined MOEs[5] |
|---|---|---|---|---|---|---|---|
| | Use Site | Route of Exposure | | | | | |
| Adult | Gardens (vegetable and ornamentals) | Dermal | 0.034 (lbs ai/gal) | 1.5 | **55** | | N/A |
| Child 6< 11 years old | | Dermal | | 0.86 | **93** | | |
| Adult | Pick-your-own Farms Low Crops (i.e., strawberries) | Dermal | 2 (lbs ai/A) | 0.923 | **87** | | |
| Child 6< 11 years old | | Dermal | | 0.414 | **190** | | |
| Adult | Pick-your-own Farms High Crops (i.e., apples) | Dermal | 3 (lbs ai/A) | 0.958 | **84** | | |
| Child 6< 11 years old | | Dermal | | 0.429 | **190** | | |
| Adult | Aerial Based ULV Mosquitocide Applications | Dermal | 0.23 (lbs ai/A) | 0.24 | **340** | | N/A |
| | | Inhalation | | N/A | **700** | | N/A |
| Children 1 to < 2 years old | | Dermal | | 0.40 | **200** | X | **170** |
| | | Inhalation | | N/A | **700** | | |
| | | Hand-to-Mouth | | 0.008 | 1,200 | X | |
| | | Object-to-Mouth | | 0.00025 | 40,000 | | N/A |
| | | Soil Ingestion | | 0.0000078 | 1,300,000 | | N/A |
| Adult | Ground Based ULV Mosquitocide Applications | Dermal | 0.11 (lbs ai/A) | 0.012 | 8,100 | | N/A |
| | | Inhalation | | N/A | 3700 | | N/A |
| Children 1 to < 2 years old | | Dermal | | 0.02 | 4,700 | X | 4,000 |
| | | Inhalation | | N/A | 3700 | | |
| | | Hand-to-Mouth | | 0.0003 | 29,000 | X | |
| | | Object-to-Mouth | | 0.00001 | 950,000 | | N/A |
| | | Soil Ingestion | | 0.0000037 | 2,700,000 | | N/A |

1 Based on registered labels (Section 3.4 and Appendix C). The "pick-your-own" post-application rates and DFR adjustment are based on the maximum agricultural application rates rather than the residential application rates. The maximum application rate for strawberries is 2 lbs au/acre and for peaches (representative orchard crop) is 3 lbs ai/acre.

2 Dose (mg/kg/day) equations provided in Appendix F.
3 Dermal and Incidental Oral MOE = POD (80 or 10 mg/kg/day) ÷ Dose (mg/kg/day) ; Inhalation MOE = HEC (52.7 mg/m$^3$) ÷ Air concentration (mg/m$^3$).
4 X indicates the exposure scenario is included in the combined MOE.
5 Combined MOE = 1 ÷ (1/dermal MOE) + (1/inhalation MOE) + (1/incidental oral MOE), where applicable ;
N/A = Not applicable

As the mosquitocide estimated risks are sensitive to several different application parameters, such as release height and droplet size. Table 6.2.3, below provides risk estimates reflecting variation of those key parameters. Additionally, the table below provides information beyond the traditional Day 0 assessment to allow for additional characterization of the rapid dissipation of malathion residues with time. Lastly, the table provides a range of MOEs incorporating the maximum, minimum and average transferrable residues from the TTR study cited above.

**TABLE 6.2.3. Aerial Mosquitocide *AgDISP* Sensitivity Analysis**

| Risk Estimate Scenarios | | MOEs[1] | | | | Inhalation Day 0 |
|---|---|---|---|---|---|---|
| | | Day 0 | Day 1 | Day 2 | Day 3 | |
| **Current Label Parameters** [2] | | | | | | |
| • 100 foot release<br>• 100% aerial deposition<br>• 60 µm droplet | **Adult dermal** | 340 – 1400 (570) | 1,400 | 5,800 | 24,000 | 700 |
| | **1< 2 years Dermal + HtM** | 170 – 700 (280) | 700 | 2,900 | 12,000 | |
| **Sensitivity Analysis** | | | | | | |
| • 300 foot release<br>• 41% aerial deposition<br>• 60 µm | **Adult dermal** | 820 – 3,400 (1400) | 3,400 | 14,000 | 60,000 | 4,400 |
| | **1< 2 years Dermal + HtM** | 410 – 1,700 (680) | 1,700 | 7,200 | 30,000 | |
| • 300 foot release<br>• 26% aerial deposition<br>• 50 µm | **Adult dermal** | 1,300 – 5,300 (2,200) | 5,400 | 23,000 | 94,000 | 5,300 |
| | **1< 2 years Dermal + HtM** | 650 – 2,700 (1100) | 2,700 | 11,000 | 47,000 | |
| • 300 foot release<br>• 18% aerial deposition<br>• 45 µm | **Adult dermal** | 1,900 – 7,800 (3200) | 7,800 | 33,000 | 140,000 | 6,600 |
| | **1< 2 years Dermal + HtM** | 940 – 3,900 (1,600) | 4,000 | 16,000 | 68,000 | |

[1] MOE = Margin of Exposure; Range represents estimated risk based on the highest and lowest Day 0 transferable residues from the previously cited TTR study. Values in parenthesis represents estimated risk based on the average Day 0 transferable residue from the four studied sites.
[2] Based on registered labels (Section 3.4 and Appendix C)

## 7.0 Non-Occupational Spray Drift Exposure and Risk Estimates

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Off-target movement of pesticides can occur via many types of pathways and it is governed by a variety of factors. Sprays that are released and do not deposit in the application area end up off-target and can lead to exposures to those it may directly contact. They can also deposit on surfaces where contact with residues can eventually lead to indirect exposures (*e.g.*, children playing on lawns where residues have deposited next to treated fields). The potential risk estimates from these residues can be calculated using drift modeling onto 50 feet wide lawns coupled with methods employed for residential risk assessments for turf products.

The approach to be used for quantitatively incorporating spray drift into risk assessment is based on a premise of compliant applications which, by definition, should not result in direct exposures to individuals because of existing label language and other regulatory requirements intended to prevent them.[10] Direct exposures would include inhalation of the spray plume or being sprayed directly. Rather, the exposures addressed here are thought to occur indirectly through contact with impacted areas, such as residential lawns, when compliant applications are conducted. Given this premise, exposures for children (1 to 2 years old) and adults who have contact with turf where residues are assumed to have deposited via spray drift thus resulting in an indirect exposure are the focus of this analysis analogous to how exposures to turf products are considered in risk assessment.

In order to evaluate the drift potential and associated risks, an approach based on drift modeling coupled with techniques used to evaluate residential uses of pesticides was utilized. Essentially, a residential turf assessment, based on exposure to deposited residues, has been completed to address drift from the agricultural applications of malathion. In the spray drift scenario, the deposited residue value was determined based on the amount of spray drift that may occur at varying distances from the edge of the treated field using the AgDRIFT (v2.1.1) model and the *Residential Exposure Assessment Standard Operating Procedures Addenda 1: Consideration of Spray Drift Policy*. Once the deposited residue values were determined, the remainder of the spray drift assessment was based on the algorithms and input values specified in the recently revised (2012) *Standard Operating Procedures For Residential Risk Assessment (SOPs)*.

For malathion, chemical-specific TTR data are available, therefore, the estimated TTR are based on a chemical specific transferable residue as discussed in Section 6.2.

A screening approach was developed based on the use of the AgDRIFT model in situations where specific label guidance that defines application parameters is not available.[11] AgDRIFT is appropriate for use only when applications are made by aircraft, airblast orchard sprayers, and groundboom sprayers. When AgDRIFT was developed, a series of screening values (i.e., the Tier 1 option) were incorporated into the model and represent each equipment type and use under varied conditions. The screening options specifically recommended in this methodology were selected because they are plausible and represent a reasonable upper bound level of drift for

[10] This approach is consistent with the requirements of the EPA's Worker Protection Standard.
[11] http://www.agdrift.com/

common application methods in agriculture. These screening options are consistent with how spray drift is considered in a number of ecological risk assessments and in the process used to develop drinking water concentrations used for risk assessment. In all cases, each scenario is to be evaluated unless it is not plausible based on the anticipated use pattern (e.g., herbicides are not typically applied to tree canopies) or specific label prohibitions (e.g., aerial applications are not allowed). Section 7.1 provides the screening level drift related risk estimates.
In many cases, risks are of concern when the screening level estimates for spray drift are used as the basis for the analysis. In order to account for this issue and to provide additional risk management options additional spray drift deposition fractions were also considered. These drift estimates represent plausible options for pesticide labels.

Spray drift assessments have been conducted to illustrate the potential for exposure from spray drift from typical agricultural applications of malathion. In addition to these scenarios, malathion also is used by several eradication programs that were assessed separately in the previous risk assessment (J. Arthur, D330678, 7/6/2006). These programs are described below:

- **Boll Weevil Eradication Program**: The Boll Weevil Eradication Program (BWEP) is a special project under the direction of the United States Department of Agriculture. This program is unique in that it attempts to systematically eradicate the boll weevil pest in cotton-growing regions of the US. This comprehensive and systematic approach was considered to be sufficiently different from normal agricultural use of malathion. In the BWEP, malathion is applied to cotton using ultra low volume (ULV) techniques (96.5% ai), at a maximum rate of 1.23 lb ai/acre, primarily by fixed-wing aircraft. This assessment covers bystander exposure in areas adjacent to areas that have been sprayed for boll weevil eradication.

- **Fruit Fly Eradication Treatment**: Treatment programs to control fruit fly pests have been undertaken in the states of California, Florida and Texas. Applications are usually made by helicopters flying at 200 to 300 feet altitude, or fixed-wing aircraft flying at 500 feet altitude. Sensitive areas, such as bodies of water are usually given a 200-foot, no-spray buffer zone. Malathion end-use products are mixed with protein hydrolase bait which is sprayed aerially or by ground sprayers, settles on target surfaces, and is eaten by the target fruit fly pests. This use is a Special Local Needs (SLN) use through several 24C labels for fruit fly treatments. The maximum application on most labels is 0.18 lb ai/acre, however one label, CA820063, is registered for a maximum application rate of 0.5 lb ai/acre.

- **USDA-APHIS Rangeland Grasshopper and Mormon Cricket Suppression Program:** This program applies malathion in a manner similar to the BWEP, only at a lower application rate (maximum of 0.62 lb ai/acre).

The application programs listed above have previously been assessed separately because a spray drift assessment had not been routinely completed in the human health risk assessments. With

the initiation of Registration Review and the finalization of the *Residential Exposure Assessment Standard Operating Procedures Addenda 1: Consideration of Spray Drift Policy*, the potential indirect non-occupational exposures from nearby commercial or agricultural applications will be completed per the spray drift policy.

## 7.1 Combined Risk Estimates from Spray Drift

The spray drift risk estimates are based on an estimated deposited residue concentration as a result of the screening level agricultural application scenarios. Malathion is registered on various agricultural crops and non-crop areas. Most of the registered products are applied either via aerial, chemigation, groundboom, airblast or with handheld equipment. The recommended drift scenario screening level options are listed below:

- **Groundboom applications** are based on the AgDRIFT option for high boom height and using very fine to fine spray type using the 90$^{th}$ percentile results.
- **Orchard airblast applications** are based on the AgDRIFT option for Sparse (Young/Dormant) tree canopies.
- **Aerial applications** are based on the use of AgDRIFT Tier 1 aerial option for a fine to medium spray type and a series of other parameters which will be described in more detail below (e.g., wind vector assumed to be 10 mph in a downwind direction for entire application/drift event).[12]

Dermal risk estimates were calculated for adults. Dermal and incidental oral risk estimates for children (1 to <2 years old) were combined because the toxicity endpoint for each route of exposure is the inhibition of RBC cholinesterase (ChE). The total applicable LOC is 1000, so MOEs < 1000 represent risk estimates of concern.

Adult dermal and children's (1 to < 2 year old) dermal and incidental oral risk estimates related to spray drift result in a range of buffers depending on the spray drift scenario. The screening level risk estimates are summarized in Table 7.1.1. In addition to the screening level spray drift scenarios as described above, additional results are provided in Appendix G which represent viable drift reduction technologies (DRTs) that represent potential risk management options. In particular, different spray qualities have been considered as well as the impact of other application conditions (e.g., boom height, use of a helicopter instead of fixed wing aircraft, crop canopy conditions). Results indicate that the major risk concern is from aerial applications. Appropriate drift reduction technologies such as changing the spray type/nozzle configuration to coarser spray applications may result in less drift and reduced risk concerns (i.e., higher MOEs)

[12] AgDrift allows for consideration of even finer spray patterns characterized as very fine to fine. However, this spray pattern was not selected as the common screening basis since it is used less commonly for most agriculture. If assessors identify this use pattern it should be used as the screening criteria and deposition values associated with it are provided in the table. In the case of malathion, fine to very fine is appropriate for ULV applications which include the uses associated with the boll weevil eradication program and for the mormon cricket suppression program.

from aerial applications. Similarly, using coarser sprays and lowering boom height for groundboom sprayers reduces risk concerns.

**Table 7.1.1. Summary of Spray Drift Buffers for Malathion.**

| Crops | Application rate[1] (lb ai/A) | Adult Dermal Buffer Summary Buffers Necessary to reach MOE of 1000 (ft) | | | Children 1 < 2 years Buffer Summary (Dermal + Incidental Oral) Buffers Necessary to reach MOE of 1000 (ft) | | |
|---|---|---|---|---|---|---|---|
| | | Aerial | Groundboom | Airblast | Aerial | Groundboom | Airblast |
| Fencerows/Hedgerows | 10.6 | >300 | 300 | 100 | >300 | >300 | 150 |
| Citrus (CA) | 7.5 | >300 | 250 | 100 | >300 | >300 | 125 |
| Kumquat, Citrus (including FL, except lemons in FL) | 4.5 | >300 | 125 | 75 | >300 | 250 | 100 |
| Nectarines, Peaches | 3 | >300 | 75 | 50 | >300 | 200 | 75 |
| Chestnut, Cotton, Pecans, Walnut | 2.5 | 300 | 75 | 50 | >300 | 150 | 75 |
| Apples | 2.23 | 250 | 75 | 50 | >300 | 125 | 75 |
| Arugula, Amaranth, Caneberries, Chervil, Chrysanthemum, Corn salad, Dock(sorrel), Figs, Orach, Ornamentals, Purslane, Strawberries, Celtuce, Florence fennel, Gooseberry, Pineapple | 2.0 | 250 | 50 | 50 | >300 | 125 | 75 |
| Chayote fruit, Cherries, Cucumber, Summer squash | 1.75 | 200 | 50 | 50 | >300 | 100 | 50 |
| Chayote root, Eggplant, Garlic, Leeks, Onions, Peppers, Bell Peppers, Potatoes, Shallots, Sweet potatoes, Tomatoes, Yams | 1.56 | 200 | 50 | 25 | >300 | 100 | 50 |
| Apricot, Beans, Celery, Lentils, Parsley, Tangerines, Watermelon, | 1.5 | 200 | 50 | 25 | >300 | 75 | 50 |
| Alfalfa, Asparagus, Barley, Beets, Broccoli, Brussel Sprouts, Cabbage, Carrot, Cauliflower, Chinese greens, Clover, Currant, Dandelion, Endive, Bermuda Grass, Forage and hay grass, Guava, Horseradish, Kohlrabi, Lemons (FL), Lespedeza, Papaya, Parsnip, Pears, Rice, Salsify, Trefoil, | 1.25 | 150 | 25 | 25 | 300 | 75 | 50 |

**Table 7.1.1. Summary of Spray Drift Buffers for Malathion.**

| Crops | Application rate[1] (lb ai/A) | Adult Dermal Buffer Summary Buffers Necessary to reach MOE of 1000 (ft) | | | Children 1 < 2 years Buffer Summary (Dermal + Incidental Oral) Buffers Necessary to reach MOE of 1000 (ft) | | |
|---|---|---|---|---|---|---|---|
| | | Aerial | Groundboom | Airblast | Aerial | Groundboom | Airblast |
| Turnips, Vetch, Watercress, Wild Rice Cotton - Boll Weevil Eradication | 1.22 | 125 | n/a | n/a | 300 | n/a | n/a |
| Chayote root, Eggplant, Garlic, Leeks, Onions, Peppers, Bell Peppers, Potatoes, Shallots, Sweet potatoes, Tomatoes, Yams | 1.0[2] | 100 | 25 | 25 | 250 | 50 | 50 |
| Blueberry (high and low bush), Honeydew | 0.77 (ULV) | 75 | 10 | 10 | 200 | 50 | 25 |
| Barley, Beans, Corn, Hops, Lespedeza, Lupine, Oats, Rice, Rye, Sorghum, Wheat, Citrus USDA-APHIS Rangeland Grasshopper and Mormon Cricket Suppression Program | 0.61 (ULV) | 75 | 10 | 10 | 125 | 25 | 25 |
| Flax | 0.5 | 50 | 10 | 0 | 100 | 25 | 25 |
| Kumquat, Tangerines | 0.18 (ULV) | 0 | 0 | 0 | 10 | 0 | 0 |

1. The mosquitocide applications are performed at an application rate of 0.23 lbs ai/acre and have been assessed separately in Section 5.2, and therefore, not included as part of the spray drift assessment.
2. Some application rates were identified in the master label report to range from 0.92-0.98 lbs ai/acre. These crops (i.e., Christmas tree plantations, Fence row/hedgerows, Honeydew, Macadamia nuts, Mango, Mint, Muskmelons, Non-agricultural/Uncultivated Areas/Soils, Pasture/Rangeland, and Shallot) have been considered under the 1.0 lbs ai/acre rate or another crop category for consideration in the spray drift assessment.

## 8.0 Residential Bystander Post-Application Inhalation Exposure

Occupational and Residential Exposure Memo: D431434, 06/09/16, S. Shelat.

Volatilization of pesticides may be a source of post-application inhalation exposure to individuals nearby pesticide applications. The Agency sought expert advice and input on issues related to volatilization of pesticides from its Federal Insecticide, Fungicide, and Rodenticide Act Scientific Advisory Panel (SAP) in December 2009, and received the SAP's final report on March 2, 2010 (http://www.epa.gov/scipoly/SAP/meetings/2009/120109meeting.html). The Agency has evaluated the SAP report and has developed a Volatilization Screening Tool and a subsequent Volatilization Screening Analysis (http://www.regulations.gov/#!docketDetail;D=EPA-HQ-OPP-2014-0219). During Registration Review, the Agency will utilize this analysis to determine if data (*i.e.,* flux studies) or further analysis are required for malathion.

The Agency has also developed a preliminary bystander volatilization inhalation exposure assessment for malathion utilizing the currently available inhalation toxicity and air monitoring data. Malathion and malaoxon were detected in multiple ambient studies. Reported detections include:

- California Department of Pesticide Regulation (CDPR) Air Monitoring Network data (AMN)
    - 2014 Salinas, California data; Shafter, California data, and Ripon, California data
    - 2013 Salinas, California data; Shafter, California data, and Ripon, California data
    - 2012 Salinas, California data; Shafter, California data, and Ripon, California data
    - 2011 Salinas, California data; Shafter, California data, and Ripon, California data
- one 2003 report for application and air monitoring in Lompoc, CA (CDPR);
- one 1999 report for application and ambient air monitoring in Imperial County (CDPR)
- one 1985 (reprinted in 1995) report for residential air monitoring in Monterey County
- one 2009 report for pesticide air monitoring in Parlier, CA
- one 2009 Organophosphate Pesticide Air Monitoring Project conducted by Washington University School of Public Health

Details of each individual study are provided in Appendix H.

Application site air monitoring (i.e., also known as field volatility) refers to the collection of air samples around the edges of a treated field during and after a pesticide application. Samples are generally collected for short intervals (e.g., < 8 hours), for at least the first day or two after application with subsequent samples increasing in duration. In this type of study, it is typically known when an application occurred, the equipment used for the application, and the application rate. Application site monitoring data represents an exposure to vapors at or near the field edge resulting from an application.

Ambient air monitoring typically is focused on characterizing the airborne pesticide levels within a localized airshed or community structure of some definition (e.g., city, township, or municipality). This type of monitoring effort also can be focused on capturing chronic background levels or other temporal characteristics of interest such as focusing on seasonal pesticide use patterns. Typically, samples are generally taken for 24 consecutive hours and collected at the same site over an extended period of time (e.g., several weeks or months). In contrast to application site air monitoring, information on the precise timing and location of pesticide applications are rarely collected in ambient air monitoring studies. However, this does not mean that an application did not occur near an ambient sampler during the monitoring period

The malathion and malaoxon bystander volatilization inhalation exposure assessment compares the maximum 24 hour air concentration detected in each of the monitoring studies to the HEC for residential bystanders (9.41 $mg/m^3$). This comparison was done to represent a potential resident who lives next to a treated field and may be exposed to the peak concentration of malathion and/or malaoxon volatilizing off the field over a 24-hour period. In addition, the arithmetic mean malathion and malaoxon air concentration from each study was compared to the HEC for

residential bystanders. This comparison was done to represent a potential seasonal exposure. Table 8.1 provides malathion and malaoxon volatilization MOE calculations for each site. None of the air concentrations results in acute or short-/intermediate-term risks of concern risks of concern with the exception of the malaoxon measurements from the application site specific monitoring done in Imperial, CA. In that study, air monitoring was conducted over a three day period to coincide with application of malathion on alfalfa. Of the 28 samples collected for malaoxon, 12 were found to be above the estimated quantitation limit (EQL) with the highest concentration observed of 440 ng/L. This measurement resulted in an MOE of 1,000 (LOC = 3,000).

| Table 8.1: RESIDENTIAL BYSTANDER: Preliminary Volatilization MOE Analysis | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| Study | Year of Study | Chemical[d] | Number of samples | Duration of samples | Duration of sampling period for average concentrations | Maximum Air Concentration ($ng/m^3$) | Average Air Concentration ($ng/m^3$) | Acute MOEs[a] **(LOC = 3,000)** | Short-term MOEs[b] **(LOC = 3,000)** |
| **Ambient Air Data** | | | | | | | | | |
| (CalDPR) Lompoc, CA | 2000 | Malathion | 451 | 24-hour | Highest 14 day average | 7.6 | 1.23 | 1,240,000 | 3,810,000 |
| | | Malaoxon | 451 | | | 2.2 | 0.43 | 190,000 | 500,000 |
| (CARB) Imperial, CA | 1999 | Malathion | 60 | 24-hour | 3 week average | 90 | 19 | 100,000 | 500,000 |
| | | Malaoxon | 60 | | | 28 | 13 | 20,000 | 30,000 |
| (CDPR and CARB) Parlier, CA | 2009 | Malathion | 468 | 24-hour | Highest 14 day average | 21 | 3.14 | 450,000 | 3,000,000 |
| | | Malaoxon | 468 | | | 16 | 3.6 | 30,000 | 120,000 |
| (CDPR AMN)[c] Salinas | 2014 | Malathion | 52 | 24-hour | Highest 4 week average | trace (12.6) | 9.8 | 750,000 | 960,000 |
| | | Malaoxon | 52 | | | trace (5.3) | 5.3 | 80,000 | 80,000 |
| (CDPR AMN)[c] Shafter | | Malathion | 52 | | | trace (12.6) | 4 | 750,000 | 2,350,000 |
| | | Malaoxon | 52 | | | trace (5.3) | 3 | 80,000 | 140,000 |
| (CDPR AMN)[c] Ripon | | Malathion | 53 | | | not detected (1.1) | 1.1 | 8,550,000 | 8,550,000 |
| | | Malaoxon | 53 | | | trace (5.3) | 4.1 | 80,000 | 100,000 |
| (CDPR AMN)[c] Salinas | 2013 | Malathion | 52 | 24-hour | Highest 4 week average | trace (12.6) | 12.6 | 750,000 | 750,000 |
| | | Malaoxon | 52 | | | trace (5.3) | 3.8 | 80,000 | 110,000 |
| (CDPR AMN)[c] Shafter | | Malathion | 52 | | | trace (12.6) | 6.9 | 750,000 | 1,360,000 |
| | | Malaoxon | 52 | | | trace (5.3) | 4.1 | 80,000 | 100,000 |
| (CDPR AMN)[c] Ripon | | Malathion | 53 | | | trace (12.6) | 4 | 750,000 | 2,350,000 |
| | | Malaoxon | 53 | | | trace (5.3) | 5.3 | 80,000 | 80,000 |
| (CDPR AMN)[c] Salinas | 2012 | Malathion | 52 | 24-hour | Highest 4 week average | trace (12.6) | 12.6 | 750,000 | 750,000 |
| | | Malaoxon | 52 | | | trace (5.3) | 5.3 | 80,000 | 80,000 |
| (CDPR AMN)[c] Shafter | | Malathion | 52 | | | trace (12.6) | 4 | 750,000 | 2,350,000 |
| | | Malaoxon | 52 | | | 10.7 | 4.3 | 40,000 | 100,000 |
| (CDPR AMN)[c] Ripon | | Malathion | 52 | | | not detected (1.1) | 1.1 | 8,550,000 | 8,550,000 |
| | | Malaoxon | 52 | | | trace (5.3) | 5.3 | 80,000 | 80,000 |
| (CDPR AMN)[c] Salinas | 2011 | Malathion | 47 | 24-hour | Highest 4 week average | 12.5 | 5.7 | 750,000 | 1,650,000 |
| | | Malaoxon | 47 | | | trace (4.0) | trace (4.0) | 110,000 | 110,000 |
| (CDPR AMN)[c] Shafter | | Malathion | 47 | | | not detected (1.1) | not detected (1.1) | 8,550,000 | 8,550,000 |
| | | Malaoxon | 47 | | | trace (4.0) | trace (1.5) | 110,000 | 290,000 |
| (CDPR AMN)[c] | | Malathion | 48 | | | trace (10.5) | trace (3.4) | 900,000 | 2,770,000 |

| Table 8.1: RESIDENTIAL BYSTANDER: Preliminary Volatilization MOE Analysis | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| Study | Year of Study | Chemical[d] | Number of samples | Duration of samples | Duration of sampling period for average concentrations | Maximum Air Concentration ($ng/m^3$) | Average Air Concentration ($ng/m^3$) | Acute MOEs[a] **(LOC = 3,000)** | Short-term MOEs[b] **(LOC = 3,000)** |
| Ripon | | Malaoxon | 48 | | | trace (4.0) | trace (3.2) | 110,000 | 130,000 |
| **Application Site Data** | | | | | | | | | |
| Imperial, CA (CARB) | 1999 | Malathion | 28 | 2 hour | 3 day | 2400 | N/A | 4,000 | N/A |
| | | Malaoxon | 28 | 8 hour | | 440 | N/A | **1,000** | N/A |

a. Acute MOE = Residential Bystander HEC (9,410,000 $ng/m^3$) / Study maximum air concentration ($ng/m^3$). LOC = 3,000

b. Short-term MOE = Residential Bystander HEC (9,410,000 $ng/m^3$) / Study arithmethic mean air concentration ($ng/m^3$). LOC = 3,000

c. All non-detects and trace concentrations reported as identified in the individual study reports. . For non-detects, assumed 1/2 Limit of Detection (LOD) of 2.2 $ng/m^3$ for malathion and 1.3 $ng/m^3$ for malaoxon. For trace concentrations, assumed concentration halfway between LOD and Limit of Quantitation of (LOQ) 9.3 $ng/m^3$ for malathion and 9.3 $ng/m^3$ for malaoxon. In the 2014 report, CDPR reports the LOQ for malathion to be 23.1 $ng/m^3$.

d. All detected or measured malaoxon air concentrations were multiplied by 22X to account for the TAF for malaoxon.

Some of the limitations and considerations that have been identified that should be considered in the interpretation of these results include:

- Most of the data utilized in this preliminary assessment are 24-hour air samples. When this data are used, an assumption is made that an individual is exposed to the same air concentration for 24-hours every day. However, this is not always the case as real world time-activity data indicate that many parts of the population move from site to site on a daily basis (*e.g.,* go to work and back).

- This assessment is only representative of outdoor concentrations (*i.e.,* the exposure and risk estimates assume an individual is outdoors all the time). It does not take into account potential effects of air conditioning systems and similar air filtration systems which could potentially reduce air concentrations of malathion and malaoxon indoors. The Agency believes that indoor concentrations will be at worst equivalent to outdoor concentrations and may potentially be lower.

- Most of the data used for this analysis have been generated in California (with one study in Washington); however, malathion is used in many regions of the country. Therefore, the results based on the limited available air monitoring data were used to represent the rest of the country due to a lack of adequate information for any other region. It is unclear what potential impacts this extrapolation might have on the risk assessment. Factors such as meteorology and cultural practices may impact the overall amounts of malathion that volatilize from a treated field as well as the rate at which it volatilizes.

- As part of the December 2009 SAP, the Agency presented their analysis of several models that could be used as screening tools to predict the air concentration and volatilization flux based on intrinsic properties and transport behaviors of pesticides. These models would allow the Agency to better represent the potential volatilization of semi-volatile pesticides across various regions of the country. The SAP provided a number of comments regarding the Agency's model analysis, including the recommendation to evaluate some additional models. The Agency is currently in the process of evaluating the SAP's comments. As appropriate, the Agency will revise the modeling approach presented to the SAP for determining the rate of volatilization (flux) for semi-volatile pesticides and for estimating air concentrations of applied pesticides in the atmosphere under varying environmental conditions. After any policies or procedures are put into place, the Agency may revisit the malathion residential bystander exposure and risk assessment.

- The residential bystander estimated exposure should not be included in the human health risk assessment aggregate since this is only a preliminary assessment and is not considered a refined assessment for the reasons noted above. There are limitations associated with the air monitoring data that are available, such as the fact that most are 24-hour air samples and that the measurement techniques do not distinguish between aerosols and vapors. In addition, as noted in the above bullet, this assessment assumes residents are outdoors during the entire exposure duration.

## 9.0 Aggregate Exposure/Risk Characterization

In accordance with the FQPA, when there are food uses of a chemical, aggregate risk assessments must be conducted that consider exposures from three major routes: oral, dermal, and inhalation. The main pathways of exposure for malathion include: dietary (food and water) and residential. In an aggregate assessment, exposures from relevant routes and pathways are added together and compared to quantitative estimates of hazard (e.g., a NOAEL or PAD), or the risks themselves can be aggregated. When aggregating exposures and risks from various sources, HED considers both the route and duration of exposure.

### 9.1 Acute Aggregate Risk

The acute aggregate risk assessment combines exposures to malathion and malaoxon from food and drinking water only. There are acute aggregate risk estimates of concern (see Section 5.4.3 Acute Dietary Assessment and Table 5.4.6.3).

### 9.2 Steady State Aggregate Risk

The steady-state aggregate assessment combines steady-state dietary (food and water) and residential exposures. The inhalation POD is based on portal of entry effects. This effect is not the same as the steady state effect of the inhibition of RBC acetylcholinesterase seen in the dermal and oral toxicity studies. Due to the difference in effects between these routes of exposure, exposures from the inhalation route cannot be aggregated with the dermal and oral routes of exposure.

Although there is the potential to aggregate steady state dermal and oral exposures from dietary and residential pathways, there are risks of concern associated with the steady-state dietary exposures as well as with many of the residential exposure scenarios. Due to the risks of concern presented by the individual scenarios, both residential and dietary, a steady state aggregate risk assessment was not conducted.

### 9.3 Cancer Aggregate Risk

Malathion is classified as "suggestive evidence of carcinogenicity, but not sufficient to assess human carcinogenic potential." Therefore, a cancer dietary exposure analysis is not required.

## 10.0 Cumulative Exposure/Risk Characterization

OPs, like malathion, share the ability to inhibit AChE through phosphorylation of the serine residue on the enzyme leading to accumulation of acetylcholine and ultimately cholinergic neurotoxicity. This shared MOA/AOP is the basis for the OP common mechanism grouping per *OPP's Guidance For Identifying Pesticide Chemicals and Other Substances that have a Common Mechanism of Toxicity (USEPA, 1999)*. The 2002 and 2006 cumulative risk assessments (CRAs) used brain AChE inhibition in female rats as the source of dose response data for the relative potency factors and PODs for each OP, including malathion. Prior to the

completion of registration review, OPP will update the OP CRA on AChE inhibition to incorporate new toxicity and exposure information available since 2006.

As described in Section 4.4, OPP has retained the FQPA Safety Factor for OPs, including malathion, due to uncertainties associated with neurodevelopmental effects in children and exposure to OPs. There is a lack of an established MOA/AOP for the neurodevelopment outcomes which precludes the Agency from formally establishing a common mechanism group per the *Guidance For Identifying Pesticide Chemicals and Other Substances that have a Common Mechanism of Toxicity* (USEPA, 1999) based on that outcome. Moreover, the lack of a recognized MOA/AOP and other uncertainties with exposure assessment in the epidemiology studies prevent the Agency from establishing a causal relationship between OP exposure and neurodevelopmental outcomes. The Agency will continue to evaluate the epidemiology studies associated with neurodevelopmental outcomes and OP exposure prior to the release of the revised PRA. During this period, the Agency will determine whether or not it is appropriate to apply the draft guidance document entitled, *Pesticide Cumulative Risk Assessment: Framework for Screening Analysis* for the neurodevelopment outcomes.

## 11.0 Occupational Exposure/Risk Characterization

Occupational and Residential Exposure Memo: DP431434, 06/09/16, S. Shelat.

### 11.1 Short- and Intermediate-Term and Steady-State Handler Exposure/Risk Estimates

HED uses the term handlers to describe those individuals who are involved in the pesticide application process. HED believes that there are distinct job functions or tasks related to applications and exposures can vary depending on the specifics of each task. Job requirements (amount of chemical used in each application), the kinds of equipment used, the target being treated, and the level of protection used by a handler can cause exposure levels to differ in a manner specific to each application event. For occupational handlers, exposure is anticipated to be to the parent, malathion, only.

The quantitative exposure/risk assessment developed for occupational handlers is based on the following scenarios which cover all the registered uses of malathion:

- Mixing/loading liquids to support aerial applications,
- Mixing/loading liquids to support airblast applications,
- Mixing/loading liquids to support chemigation applications,
- Mixing/loading liquids to support groundboom applications,
- Mixing/loading liquids to support dip applications,
- Loading dust via power duster,
- Mixing/loading liquids to support aerial and ground ULV applications,
- Applying sprays via aerial application,
- Applying sprays via groundboom application,
- Applying sprays via airblast application,
- Applying via dip application,
- Flagging to support aerial applications,
- Mixing/loading/applying liquids via backpack,
- Mixing/loading/applying liquids via mechanically-pressurized handgun,

- Mixing/loading/applying liquids via manually-pressurized handwand,
- Mixing/loading/applying liquids via handheld fogger,
- Applying dust via power duster, and
- Applying via aerial and ground ULV applications.

Occupational Handler Exposure Data and Assumptions

A series of assumptions and exposure factors served as the basis for completing the occupational handler risk assessments. Assumptions and factors, as well as algorithms used to estimate non-cancer exposure and dose for occupational handlers are detailed in the most recent ORE memo (S. Shelat; D431434; 06/09/2016).

For adults, when an endpoint is not sex-specific (i.e., the endpoints are based on developmental or fetal effects) a body weight of 80 kg is typically used in risk assessment; however, in this case, a female-specific body weight of 69 kg was used. While the endpoints of concern, RBC AChE inhibition and inhalation portal of entry effects, are not sex-specific, the female-specific body weight was used to protect for pregnant women due to uncertainty in the human dose-response relationship for neurodevelopmental effects (See Section 4.4).

The steady-state approach is appropriate for malathion given the toxicological and exposure profile. The steady-state dermal endpoint selection for malathion overlaps with HED's traditional short-term exposure duration endpoint selection and is considered health protective for occupational handlers that apply commercially over longer periods of time (i.e., intermediate-term exposures).

MRID: 46634105 Determination of Dermal and Inhalation Exposure to Workers during Closed-System Loading and ULV Application of a Liquid Pesticide Product to Cotton." (DP Barcode: 324585; Decision#: 330654)

The purpose of the study was to determine the dermal and inhalation exposure of handlers from the closed-system loading of a liquid pesticide in support of large volume aerial spraying, as well as the dermal and inhalation exposure of pilots spraying large acreage crops (cotton) with an ULV formulation by fixed-wing aircraft. EPA estimated dermal and inhalation unit exposure values as µg/lb ai handled. Inhalation unit exposure values were calculated assuming a breathing rate of 0.0167 $m^3$/minute for loaders (NAFTA light inhalation rate) and 0.0083 $m^3$/minute for applicators (NAFTA sedentary inhalation rate). Both generic and chemical-specific data were used as part of the assessment for ULV applications.

While there are certain issues with regard to the conduct and results of the study, none are sufficient to preclude the use of the exposure data for exposure/risk assessment purposes. It is important to note that the hand exposure data were obtained using gloved hands, and therefore, the use of these data in exposure/risk assessments must assume that workers will be wearing gloves during the mixing/loading activity.

Lastly, there remains a data gap for the power duster for grain storage facilities and the handheld fogger for mushroom houses. For malathion, the dust formulation (EPA Reg No. 1015-69) is

only registered for post-harvest application to raw agricultural commodities (wheat, corn, oats, barley, and rye). The mixer/loader scenario for the power duster has been assessed using the wettable powder loader unit exposures. The applicator scenario for the power duster has not been quantitatively assessed due to lack applicable unit exposures currently available. The mixer/loader/applicator handheld fogger scenario has not been quantitatively assessed due to a lack representative data to lack applicable unit exposures currently available.

Estimates of dermal and inhalation exposure were calculated for baseline attire in addition to various levels of PPE. Results are presented for "baseline," defined as a single layer of clothing consisting of a long sleeved shirt, long pants, shoes plus socks, no protective gloves, and no respirator, as well as baseline with various levels of PPE as necessary (e.g., gloves, respirator, etc). Most of the liquid formulation malathion registered labels require handlers to wear a single layer of clothing (long sleeved shirt and long pants), shoes plus socks, protective eyewear (either goggles or face shield), chemical-resistant gloves, and chemical-resistant apron. One label (EPA Reg No. 4-122) also required handlers to wear coveralls. The dust formulation malathion registered label requires handlers to wear coveralls over long-sleeved shirts, long pants, shoes and socks, protective eyewear, chemical-resistant gloves, and NIOSH approved respirator with any N, R, P, or HE filter, along with chemical-resistant headgear when overheard exposure is expected.

Summary of Occupational Handler Non-Cancer Exposure and Risk Estimates

The occupational handler exposure and risk estimates indicate that most dermal and inhalation MOEs are of concern to HED (i.e., dermal MOE < 1000, inhalation MOE < 3000) for most scenarios assuming the use of label-required PPE (gloves). Table 11.1.1 provided a risk estimate summary of the exposure scenario, application method, and application rate combinations that do not result in risks of concern (i.e., dermal MOE $\geq$ 1000, inhalation MOE $\geq$ 3000) with the label-required PPE. Application rates greater than those identified may require risk mitigation. The risk estimates for all registered occupational malathion uses and risk mitigation options (i.e., PPE and engineering controls) is provided in Appendix I.

In general, most typical, high-acreage, and non-agricultural uses are of concern for dermal exposure with label required PPE (i.e., gloves). Additionally, some scenarios do not reach acceptable MOEs even with the highest level of risk mitigation. For inhalation exposure, most scenarios reach the acceptable MOE of 3000 at label required PPE (no respirator) with the exception of higher use rates and applying via airblast equipment.

HED has no data to assess exposures to pilots using open cockpits. The only data available is for exposure to pilots in enclosed cockpits. Therefore, risks to pilots are assessed using the engineering control (enclosed cockpits) and baseline attire (long-sleeve shirt, long pants, shoes, and socks); per the Agency's Worker Protection Standard stipulations for engineering controls, pilots are not required to wear protective gloves for the duration of the application. Dermal risk estimates do not reach acceptable MOEs (MOEs < 1000) with engineering controls for a number of higher application rates.

The Agency matches quantitative occupational exposure assessment with appropriate characterization of exposure potential. While HED presents quantitative risk estimates for human

flaggers where appropriate, agricultural aviation has changed dramatically over the past two decades. According the 2012 National Agricultural Aviation Association (NAAA) survey of their membership, the use of GPS for swath guidance in agricultural aviation has grown steadily from the mid 1990's. Over the same time period, the use of human flaggers for aerial pesticide applications has decreased steadily from ~15% in the late 1990's to only 1% in the most recent (2012) NAAA survey. The Agency will continue to monitor all available information sources to best assess and characterize the exposure potential for human flaggers in agricultural aerial applications. HED recommends that the PPE on the registered malathion labels for flaggers be revised to reflect the information provided below in Table 11.1.1. To reach acceptable MOEs for flagging activities associated with application rates greater than 0.63 lbs ai/acre, risk mitigation may be considered.

**Table 11.1.1 Risk Estimate Summary of Registered Malathion Occupational Uses – Scenarios that DO NOT result in risk estimates of concern with label-required PPE.**

| | Exposure Scenario | Dermal | Inhalation |
|---|---|---|---|
| Mixing/Loading for Aerial Applications | Typical field crops | No registered rates result in MOEs ≥ 1000 | ≤ 1.00 lbs ai/A |
| | High acreage field crops | No registered rates result in MOEs ≥ 1000 | No registered rates result in MOEs > 3000 |
| | Nursery (ornamentals, vegetables, trees, container stock) | MOEs > 1000 at labeled rate (0.25 lbs ai/A) | MOEs > 3000 at labeled rate (0.25 lbs ai/A) |
| | Field-grown ornamental crops | MOEs > 1000 at labeled rate (0.25 lbs ai/A) | MOEs > 3000 at labeled rate (0.25 lbs ai/A) |
| | Non-Agricultural Sites | No registered rates result in MOEs ≥ 1000 | MOEs > 3000 at labeled rates |
| | ULV Agricultural sites with MRID 466341-05 data | ≤ 0.18 lbs ai/A | MOEs > 3000 at labeled rates |
| | ULV Agricultural site with generic data | No registered rates result in MOEs ≥ 1000 | No registered rates result in MOEs > 3000 |
| | ULV Non-agricultural sites with MRID 466341-05 data | ≤ 0.23 lbs ai/A | ≤ 0.93 lbs ai/A |
| | ULV Non-agricultural sites with generic data | No registered rates result in MOEs ≥ 1000 | No registered rates result in MOEs > 3000 |
| Mixing/Loading for Chemigation Applications | Typical field crops | < 0.5 lbs ai/A | ≤ 1.00 lbs ai/A |
| | Nursery (ornamentals, vegetables, trees, container stock) | MOEs > 1000 at labeled rate (1 lbs ai/A) | MOEs > 3000 at labeled rate (1 lbs ai/A) |
| | Field-grown ornamental crops | MOEs > 1000 at labeled rate (1 lbs ai/A) | MOEs > 3000 at labeled rate (1 lbs ai/A) |
| Mixing/Loading for Groundboom Applications | Typical field crops | ≤ 1.75 lbs ai/A | MOEs > 3000 at labeled rates |
| | High acreage field crops | < 1 lbs ai/A | MOEs > 3000 at labeled rates |
| | Nursery (ornamentals, vegetables, trees, container stock) | MOEs > 1000 at labeled rate (1 lbs ai/A) | MOEs > 3000 at labeled rates |
| | Field-grown ornamental crops | MOEs > 1000 at labeled rate (1 lbs ai/A) | MOEs > 3000 at labeled rates |
| | Non-Agricultural Sites | MOEs > 1000 at labeled rate (1 lbs ai/A) | MOEs > 3000 at labeled rates |
| | ULV Agricultural sites with MRID 466341-05 data | MOEs > 1000 at labeled rates | MOEs > 3000 at labeled rates |
| | ULV Agricultural site with generic data | ≤ 0.94 lbs ai/A | MOEs > 3000 at labeled rates |
| | ULV Non-agricultural sites with MRID 466341-05 data | ≤ 10.6 lbs ai/A | MOEs > 3000 at labeled rates |
| | ULV Non-agricultural site with generic data | ≤ 0.93 lbs ai/A | < 0.23 lbs ai/acre |

**Table 11.1.1 Risk Estimate Summary of Registered Malathion Occupational Uses – Scenarios that DO NOT result in risk estimates of concern with label-required PPE.**

| Exposure Scenario | | Dermal | Inhalation |
|---|---|---|---|
| Mixing/Loading for Truck-Mounted Fogger Application | Non-Agricultural Sites | MOEs > 1000 at labeled rate 0.51 lbs ai/A) | MOEs > 3000 at labeled rates |
| Mixing/Loading for Airblast Applications | Nursery (ornamentals, vegetables, trees, container stock) | No registered rates result in MOEs ≥ 1000 | MOEs > 3000 at labeled rates |
| | Field-grown ornamental crops | No registered rates result in MOEs ≥ 1000 | MOEs > 3000 at labeled rates |
| | Tree plantations and Typical field crops | ≤ 3.2 lbs ai/A | MOEs > 3000 at labeled rates |
| Mixing/Loading for Mechanically-pressurized Handgun Applications | Non-Agricultural Sites | No registered rates result in MOEs ≥ 1000 | No registered rates result in MOEs > 3000 |
| Loading to Support Power Duster Applications | Stored Grain | MOEs > 1000 at labeled rate (0.00062 and 0.0003 lbs ai/sq ft) | The rates of 0.00062 result in MOEs < 3000 and 0.0003 lbs ai/sq ft result in MOEs > 3000 |
| Applying via Aerial Applications | Typical field crops | ≤ 7.5 lbs ai/A | MOEs > 3000 at labeled rates |
| | High acreage field crops | < 2.5 lbs ai/A | MOEs > 3000 at labeled rates |
| | Nursery (ornamentals, vegetables, trees, container stock) | MOEs > 1000 at labeled rate (0.25 lbs ai/A) | MOEs > 3000 at labeled rates |
| | Field-grown ornamental crops | MOEs > 1000 at labeled rate (0.25 lbs ai/A) | MOEs > 3000 at labeled rates |
| | Non-Agricultural Sites | MOEs > 1000 at labeled rates | MOEs > 3000 at labeled rates |
| | ULV Agricultural sites with MRID 466341-05 data | ≤ 0.18 lbs ai/A | ≤ 0.77 lbs ai/A |
| | ULV Agricultural site with generic data | ≤ 0.18 lbs ai/A | MOEs > 3000 at labeled rates |
| | ULV Non-agricultural sites with MRID 466341-05 data | ≤ 0.23 lbs ai/A | ≤ 0.93 lbs ai/A |
| | ULV Non-agricultural site with generic data | ≤ 0.23 lbs ai/A | ≤ 10.6 lbs ai/A |
| Applying via Groundboom Applications | Typical field crops | ≤ 2 lbs ai/A | ≤ 2.0 lbs ai/A |
| | High acreage field crops | ≤ 1.25 lbs ai/A | ≤ 1.25 lbs ai/A |
| | Nursery (ornamentals, vegetables, trees, container stock) | MOEs > 1000 at labeled rate (1 lbs ai/A) | MOEs > 3000 at labeled rates |
| | Field-grown ornamental crops | MOEs > 1000 at labeled rate (1 lbs ai/A) | MOEs > 3000 at labeled rates |
| | Non-Agricultural Sites | MOEs > 1000 at labeled rates | MOEs > 3000 at labeled rates |
| | ULV Agricultural site with generic data | MOEs > 1000 at labeled rates | MOEs > 3000 at labeled rates |
| | ULV Non-agricultural site with generic data | ≤ 0.93 lbs ai/A with exception of public health uses (MOEs = 550) | No registered rates result in MOEs > 3000 |

**Table 11.1.1 Risk Estimate Summary of Registered Malathion Occupational Uses – Scenarios that DO NOT result in risk estimates of concern with label-required PPE.**

| Exposure Scenario | | Dermal | Inhalation |
|---|---|---|---|
| Applying via Truck-Mounted Fogger Application | Non-Agricultural Sites | No registered rates result in MOEs ≥ 1000 | No registered rates result in MOEs > 3000 |
| Applying via Mechanically-pressurized handgun | Non-Agricultural Sites | No registered rates result in MOEs ≥ 1000 | No registered rates result in MOEs > 3000 |
| Applying via Power Duster | Stored Grain | Data Gap | Data Gap |
| Applying via Airblast Applications | Nursery (ornamentals, vegetables, trees, container stock) | No registered rates result in MOEs ≥ 1000 | No registered rates result in MOEs > 3000 |
| | Field-grown ornamental crops | No registered rates result in MOEs ≥ 1000 | No registered rates result in MOEs > 3000 |
| | Tree plantations and Typical field crops | No registered rates result in MOEs ≥ 1000 | No registered rates result in MOEs > 3000 |
| Flagging | All use sites | ≤ 1.25 lbs ai/A | ≤ 0.63 lbs ai/A |
| Backpack Applications | Tree plantations | No registered rates result in MOEs ≥ 1000 | No registered rates result in MOEs > 3000 (3.2 lbs a/acre) |
| | Mushroom houses | | MOEs > 3000 at labeled rate (1.7 lbs ai/A) |
| | Foliar and Ground-directed ornamentals | | MOEs > 3000 at labeled rate (0.025 lbs ai/gallon) |
| Manually-pressurized Handgun Applications | Non-Agricultural Sites | No registered rates result in MOEs ≥ 1000 | See Appendix H[1] |
| | Tree plantations, ornamentals (foliar-directed) | No registered rates result in MOEs ≥ 1000 (exceptions below) | No registered rates result in MOEs > 3000 (3.2 lbs ai/acre) |
| | Mushroom houses | MOEs > 1000 at labeled rate (1.7 lbs ai/A) | MOEs > 3000 at labeled rate (1.7 lbs ai/A) |
| | Ornamentals | MOEs > 1000 at labeled rate (0.025 lbs ai/gallon) | MOEs > 3000 at labeled rate (0.025 lbs ai/gallon) |
| Mechanically-pressurized handgun Applications | Non-Agricultural Sites | See Appendix H[1] | See Appendix H[1] |
| | Mushroom houses | MOEs > 1000 at labeled rate (1.7 lbs ai/A) | MOEs > 3000 at labeled rate (1.7 lbs ai/A) |
| | Ornamentals | No registered rates result in MOEs > 1000 | No registered rates result in MOEs > 3000 (0.025 lbs ai/gallon) |
| Dip Applications | Non-Agricultural Sites | See Appendix H[1] | See Appendix H[1] |
| | Grape root | MOEs > 1000 at labeled rates | MOEs > 3000 at labeled rates |

**Table 11.1.1 Risk Estimate Summary of Registered Malathion Occupational Uses – Scenarios that DO NOT result in risk estimates of concern with label-required PPE.**

| Exposure Scenario | | Dermal | Inhalation |
|---|---|---|---|
| Handheld Fogger Applications | Mushroom houses | Data Gap | Data Gap |

1. Appendix I is identified for some exposure scenario combinations because the amount handled/area treated assumptions vary across the uses, making it difficult to identify an application rate where the MOEs are not of concern to HED (i.e., dermal MOEs ≥ 1000 and inhalation MOEs ≥ 3000). Please see Appendix I for the individual risk estimates.

## 11.2 Steady-State Post-Application Exposure/Risk Estimates

HED uses the term post-application to describe exposures that occur when individuals are present in an environment that has been previously treated with a pesticide (also referred to as re-entry exposure). Such exposures may occur when workers enter previously treated areas to perform job functions, including activities related to crop production, such as scouting for pests or harvesting. Post-application exposure levels vary over time and depend on such things as the type of activity, the nature of the crop or target that was treated, the type of pesticide application, and the chemical's degradation properties. In addition, the timing of pesticide applications, relative to harvest activities, can greatly reduce the potential for post-application exposure.

For adults, when an endpoint is not sex-specific (i.e., the endpoints are based on developmental or fetal effects) a body weight of 80 kg is typically used in risk assessment; however, in this case, a female-specific body weight of 69 kg was used. While the endpoints of concern, RBC AChE inhibition and inhalation portal of entry effects, are not sex-specific, the female-specific body weight was used to protect for pregnant women due to uncertainty in the human dose-response relationship for neurodevelopmental effects (See Section 4.4).

### 11.2.1 Occupational Post-application Inhalation Exposure/Risk Estimates

There are multiple potential sources of post-application inhalation exposure to individuals performing post-application activities in previously treated fields. These potential sources include volatilization of pesticides and resuspension of dusts and/or particulates that contain pesticides. The Agency sought expert advice and input on issues related to volatilization of pesticides from its Federal Insecticide, Fungicide, and Rodenticide Act Scientific Advisory Panel (SAP) in December 2009, and received the SAP's final report on March 2, 2010 (http://www.epa.gov/scipoly/SAP/meetings/2009/120109meeting.html). The Agency has evaluated the SAP report and has developed a Volatilization Screening Tool and a subsequent Volatilization Screening Analysis (http://www.regulations.gov/#!docketDetail;D=EPA-HQ-OPP-2014-0219). During Registration Review, the Agency will utilize this analysis to determine if data (i.e., flux studies) or further analysis is required for malathion.

In addition, the Agency is continuing to evaluate the available post-application inhalation exposure data generated by the Agricultural Reentry Task Force. Given these two efforts, the Agency will continue to identify the need for and, subsequently, the way to incorporate occupational post-application inhalation exposure into the Agency's risk assessments.

### 11.2.2 Occupational Post-application Dermal Exposure/Risk Estimates

Occupational Post-application Dermal Exposure Data and Assumptions

A series of assumptions and exposure factors served as the basis for completing the occupational post-application risk assessments. Assumptions and factors, as well as the algorithms used to estimate non-cancer exposure and dose for occupational post-application workers are detailed in the most recent ORE memo (S. Shelat; D431434; 06/09/2016).

The steady-state approach is appropriate for malathion dermal exposure given the toxicological and exposure profile. The "steady-state" endpoint selection for malathion overlaps with HED's traditional short-term exposure duration endpoint selection as well as being appropriately health protective for workers that are exposed over longer periods of time (i.e., intermediate-term exposures).

Chemical-specific DFR data have been submitted for malathion. A total of six chemical-specific DFR data sets have been submitted for malathion on the following crops: grapes (MRID 450059-10), wine grapes (MRID 454919-01), Apples (MRID 451382-02), summer squash (MRID 454919-02), blackberries (MRID 451382-01), and nursery stock (MRID 454695-01). All six studies have been reviewed by HED and found to be acceptable for risk assessment.

A summary of how the DFR data were used is summarized in Table 11.2.2.1 and discussed in the most recent ORE memo (S. Shelat; D431434; 06/09/2016).

**Table 11.2.2.1. Summary of DFR Data Use in Post-application Assessment for Malathion**

| Crop for which DFR data available | Locations included in study | Crops for which DFR data used as surrogate |
|---|---|---|
| Grapes<br>MRID 450059-10 | California (CA) | blueberry (highbush), currant, grape, hop, and passion fruit |
| Wine Grapes<br>MRID 454919-01 | California (CA) | these data were not extrapolated because the grape study represent a more conservative surrogate |
| Apples<br>MRID 451382-02 | Pennsylvania (PA) | apricot, avocado, cherry, chestnut, date, fig, grapefruit, guava, kumquat, lemon, lime, macadamia nut, mango, nectarine, orange, papaya, peach, pear, pecan, tangelo, tangerine, walnut, pine seed orchards and Christmas tree plantation |
| Summer Squash<br>MRID 454919-02 | California (CA) | alfalfa, asparagus, barley, bean, bermuda grass, beet, broccoli, broccoli-raab, brussels sprout, cabbage, carrot, cantaloupe, cauliflower, celery, chayote root, chayote fruit, chinese broccoli, chinese green, clover, collards, corn, cotton, cucumber, cut flowers, dandelion, eggplant, endive, flax, garlic, grasses (hay, forage), horseradish, kale, kohlrabi, leeks, lespedeza, lettuce, lupine, melon, mint, mushroom, mustard greens, oats, okra, onion, parsley, parsnip, pea, pepper, potato, pumpkin, radish, rice, rutabaga, rye, salsify, shallot, sorghum grain, spinach, squash, sweet potato, Swiss chard, tomato, tomatillo, turnip, vetch, watercress, watermelon, wheat, wild rice and yam. |
| Blackberries<br>MRID 451382-01 | Oregon (OR) | blackberry, blueberry (lowbush), boysenberry, dewberry, gooseberry, loganberry, pineapple, raspberry and strawberry |
| Nursery Stock<br>MRID 454695-01 | Arizona (AZ) | all currently labeled ornamental crops including nursery stock and shrubs |

For use on cotton, HED has also assessed the post-application dermal exposure and risk estimates for workers involved in harvesting cotton bolls. Although most of cotton harvesting is done mechanically, there are still some activities, with the potential for exposure, that are associated with the harvesting of cotton. The anticipated post-application activities and dermal transfer coefficients for these activities are presented in Table 8.2.2.2. The recommended transfer coefficients are derived from EPA's Science Advisory Council for Exposure (ExpoSAC)

Policy 3 (http://www.epa.gov/pesticides/science/exposac-policy3-march2013.pdf). No chemical specific data are available for the amount of residue available on the cotton bolls; i.e., dislodgeable boll residue (DBR) data. Such data are available from a study with the active ingredient tribufos; i.e., MRID 42701601[13]. **Note to PRD: These data may be proprietary, and subject to the data protection provisions of FIFRA, and therefore, may trigger a data compensation issue between registrants.** Since the proposed malathion labels include a 7 day pre-harvest interval, the best fit residue data used from MRID 42701601 was chosen from day 0 and day 7 after application and then adjusted for the difference in application rates.

**Table 11.2.2.2. Anticipated Post-Application Activities and Transfer Coefficients for Cotton Harvesters.**

| Crop | Policy Crop Group Category | Crop Height | Foliage Density | Transfer Coefficients | Activities |
|---|---|---|---|---|---|
| Cotton | Field / row. crop, low / medium | High | Min | 900 g cotton boll/hr | Mechanical Harvesting (Module Builder Operator) |
| | | | | 2,400 g cotton boll/hr | Mechanical Harvesting (Picker Operator and Raker) |
| | | | | 5,050 g cotton boll/hr | Mechanical Harvesting (Tramper) |

As mentioned earlier, malaoxon is a metabolite of malathion and is 22 times more toxicologically potent than malathion. Since the POD for the dermal route of exposure was chosen from a malathion toxicity study, a TAF 22 was chosen to account for the increased potency of malaoxon in exposure calculations. A total toxic residue approach was used whereby calculated residues of malaoxon (malathion residues × 5%) were adjusted by the TAF, and total residues (malathion + adjusted malaoxon) were include in exposure calculations[14].

*TTR Data:* One TTR study has been submitted for malathion on turf. Four sites were provided in the study. The study that resulted in the maximum predicted residue was considered in the post-application scenarios that used the TTR data. The study has been reviewed by HED and found to be acceptable for risk assessment.

Occupational Post-application Non-Cancer Dermal Risk Estimates

The post-application exposure scenarios associated with the registered uses of malathion are provided in Appendix J and discussed in the most recent ORE memo (S. Shelat; D431434; 06/09/2016). The resulting risk-based REIs are summarized in Table 11.2.2.3.

Restricted Entry Interval (REI)

Current product-label REIs range from 12 to 48 hours depending on the crop. Based on the current post-application dermal exposure assessment (Table 11.2.2.3), REIs of 12 hours to 9 days with one scenario as high as 13 days (i.e., grapes) would be necessary to reach acceptable MOEs (i.e., MOEs ≥ 1000) from exposure to the combined residues of malathion and malaoxon. Table 11.2.2.3 provides a summary of the current REIs on product labels and the REIs based on the

[13] MRID 42701601 was reviewed in 1997 and 1999 within the following memos: B. Tarplee, D227007, 02/12/1997; T. Leighton, D252221 01/26/1999

[14] Total DFR, ug/cm$^2$ = [ (Malaoxon residue, ug/cm$^2$) * TAF] + [Malathion residue, ug/cm$^2$)

quantitative post-application exposure assessment for malathion which would be needed to achieve risks which were not of concern.

The 12 hours REIs are in line with the 40 CFR 156.208 (c) (2) assignments for active ingredients that are classified as Toxicity Category III and IV for acute dermal, eye irritation, and primary skin irritation.

**Table 11.2.2.3. Summary of Restricted Entry Intervals**

| Crop[1] | REI on Current labels (hours) | HED recommended REI days |
|---|---|---|
| Alfalfa (field and seed crop) | 12 | 6-7<br>5-6 (ULV) |
| Amaranth | 12 | 2-8 |
| Apricots | 12 | 12 hours -6 days |
| Arugula | 12 | 2-8 |
| Asparagus | 12 | 1-7 |
| Avocado | 48 | 2-7 |
| Barley | 12 | 6<br>(ULV) 5 |
| Beans (snap, lima, dry, and succulent) | 12 | (ULV) 12 hours – 6 days |
| Beets (table, garden) | 12 | 1-7 |
| Blueberry (high and low bush) | 12 | 12 hours – 3 days<br>(ULV) 12 hours – 2 days |
| Brambles (Blackberry, Boysenberry, Dewberry, Loganberry, Raspberry) | 12 | 1-4 |
| Broccoli (Chinese, rabb) | 48 | 3-8 |
| Brussel sprouts | 48 | 3-8 |
| Cabbage | 48 | 3-8 |
| Cantaloupe | 12 | 1-7 |
| Carrots | 24 | 1-7 |
| Cauliflower | 48 | 3-8 |
| Cavalo Broccolo | 48 | 3-8 |
| Celery | 24 | 2-7 |
| Celtuce | 12 | 2-8 |
| Chayote fruit | 24 | 2-7 |
| Chayote root | 24 | 1-7 |
| Cherries (tart, sweet) | 12 | 12 hours – 7 days<br>(ULV) 12 hours – 6 days |
| Chervil | 12 | 2-8 |
| Chestnut | 24 | 12 hours – 4 days |
| Chinese Cabbage, Mustard | 48 | 3-8 |
| Christmas tree plantations | 12 | 1-7<br>(ULV) 12 hours - 4 days |
| Chrysanthemum | 12 | 2-8 |
| Citrus - non-bearing (Excluding CA) | 72<br>12 | 12 hours-7 days<br>(ULV) 12 hours |
| Citrus - non-bearing (CA Only) | 72 | (CA only) 3-8 |
| Citrus Fruits (Excluding CA) | 72 | 12 hours-7 days<br>(ULV) 12 hours |
| Citrus Fruits (CA Only) | 72 | (CA only) 3-8 |

**Table 11.2.2.3. Summary of Restricted Entry Intervals**

| Crop[1] | REI on Current labels (hours) | HED recommended REI days |
|---|---|---|
| Clover, Clover Seed | 12 | 6-7<br>5-6 (ULV) |
| Collards | 12 | 1-7 |
| Corn (field, sweet, pop) | 72 – detasseling<br>12 – other activities | 1-7; 9 (detasseling)<br>(ULV) 12 hours – 6; 8 (detasseling) |
| Corn Salad | 12 | 2-8 |
| Cotton | 48 | 2-4 (mechanical harvesting 15 days)<br>(ULV) 1-4 (mechanical harvesting 12 days) |
| Cucumber | 24 | 2-7 |
| Currant | 12 | 12 hours – 3 days |
| Dandelion | 24 | 1-7 |
| Dock (sorrel) | 12 | 2-8 |
| Eggplant | 12-24 | 2-7 |
| Endive (escarole) | 24 | 1-7 |
| Figs | 12-24 | 12 hours – 5 days |
| Flax | 12 | 4 |
| Florence Fennel | 24 | 2-8 |
| Garlic | 24 | 4-9 |
| Gooseberry | 12 | 1- 4 |
| Grapes (raisin, table, wine, vineyard) | 72-girdling and tying<br>24-all other activities | 12 hours – 13 days<br>(ULV) 12 hours |
| Grass (forage, hay, bermuda, rangeland) | 12 | 6-7<br>(sod) 9 |
| Guava | 12 | 12 hours – 4 days |
| Honeydew (melons) | 12 | 1-7 |
| Hops | 12 | 12 hours – 9 days |
| Horseradish | 24 | 1-7 |
| Kale | 12 | 1-7 |
| Kohlrabi | 24 | 4-8 |
| Kumquat | 48 | 2-7<br>(ULV) 12 hours |
| Leeks | 24 | 4-9 |
| Lemons (FL only) | 12 | 12 hours – 4 days |
| Lentils | 12 | (ULV) 12 hours – 6 days |
| Lespedeza (plant, seed) | 12 | 6-7<br>5-6 (ULV) |
| Lettuce (head, leaf) | 24 | 2-8 |
| Lupine (plant, seed) | 12 | 6-7<br>5-6 (ULV) |
| Macadamia Nut | 12 | 12 hours – 2 days |
| Mango | 12 | 2-5 |
| Melons | 12 | 1-7 |
| Mint | 12 | 1-6 |
| Mizuna | 12 | 3-8 |
| Mushrooms | 12 | 5 |
| Muskmelons (melons) | 12 | 1-7 |
| Mustard (greens, spinach) | 12-48 | 1-7 |
| Nectarines | 24 | 1-8 |
| Oats | 12 | 1-6<br>(ULV) 12 hours – 5 days |

**Table 11.2.2.3. Summary of Restricted Entry Intervals**

| Crop[1] | REI on Current labels (hours) | HED recommended REI days |
|---|---|---|
| Okra | 12 | 1-7 |
| Onions (bulb and green) | 12 | 4-9 |
| Orach | 12 | 2-8 |
| Ornamentals in outdoor nurseries | 12 | 12 hours- 9 days |
| Papaya | 12 | 12 hours – 4 days |
| Parsley | 24 | 2-7 |
| Parsnip | 24 | 1-7 |
| Passion Fruit | 12 | 12 hours – 9 days |
| Pasture and Rangeland | 12 | |
| Peaches | 24 | 1-8 |
| Pears | 12 | 12 hours -6 days |
| Peas (dry, succulent, green) | 12 | 1 - 7 |
| Pecans | 24 | 12 hours – 4 days |
| Peppers, Bell Peppers | 12 | 2-7 |
| Pine Seed Orchards | 12 | 1-9<br>(ULV) 12 hours – 7 days |
| Pineapples | 24 | 2-7 |
| Potatoes | 12 | 2-7 |
| Pumpkins | 12 | 1-7 |
| Purslane (garden) | 12 | 2-8 |
| Radish, Rutabaga | 12 | 1-7 |
| Rape Greens (broccoli) | 48<br>12 | 3-8 |
| Rice, Wild Rice | 12 | 6<br>(ULV) 5 |
| Rye | 12 | 1-6<br>(ULV) 12 hours- 5 days |
| Salsify | 24 | 1-7 |
| Shallot | 24 | 4-9 |
| Slash Pine (Christmas Tree Planation) | 12 | 1-7<br>(ULV) 12 hours - 4 days |
| Sorghum | 12 | 1-3<br>(ULV) 12 hours – 2 days |
| Spinach | 12 | 2-8 |
| Squash, summer | 24 | 2-7 |
| Squash, winter | 12 | 1-7 |
| Strawberries | 12 | 12 hours – 3 days |
| Sweet Potatoes | 12 | 2-7 |
| Swiss Chard | 12 | 1-7 |
| Tangerines | 72 | 12 hours – 8 days<br>(ULV) 12 hours |
| Tomatoes | 12 | 2-7 |
| Trefoil (birdsfoot) (peas) | 12 | 1 - 7 |
| Turnip (roots, greens) | 24 | 1-7 |
| Vetch | 12 | 6-7<br>(ULV) 5-6 |
| Walnuts | 24 | 12 hours – 4 days |
| Watercress | 12-24 | 1-7 |
| Watermelon | 12 | 2-7 |
| Wheat (spring, winter) | 12 | 1-6<br>(ULV) 12 hours – 5 days |

| Table 11.2.2.3. Summary of Restricted Entry Intervals | | |
|---|---|---|
| Crop[1] | REI on Current labels (hours) | HED recommended REI days |
| Yams | 24 | 2-7 |

1. Amaranth, Arugula, Celtuce, Chervil ,Chrysanthemum, Corn Salad, Dock Sorrel, Floence Fennel, Orach, and Purslane are all registered under Leafy Vegetables (Except Brassica Vegetables) within EPA Reg No. 10163-21 at a registered maximum application rate of 2.0 lbs ai/A. The spinach post-application scenario is used as a surrogate.

## 12.0 References


**Malathion:** Occupational and Residential Exposure and Risk Assessment for Registration Review. D431434, 06/09/2016, S. Shelat.

**Malathion:** Tier II Incident Report. D423155, 9/30/2014, S. Recore et al.

**Malathion:** Addendum to Tier II Incident Report dated 09/30/14, D426077, 6/10/2016, C. Williams, et al.

**Malathion:** Acute and Steady State Aggregate (Food and Drinking Water) Dietary Exposure and Risk Assessments to Support Registration Review. D428996, 6/07/2016, S. Piper.

**Malathion:** Drinking Water Assessment for Registration Review of Malathion. D420234, 08/13/2015, A. Shelby.

**Malathion**: Establishment of Tolerance for Adulticide Use, Revised, D420237, 06/07/2016, M. Sahafeyan.

**Malathion:** Magnitude Field Crop Trials Residue of Concern. D178477, 8/08/1992, B. Dementi. Metabolism Meeting Held on 2/12/1992.

**Malathion:** Response to the Malathion Reregistration Standard Confined Rotational Crop Study. DP196880; 05/26/1994; R. Perfetti.


## Appendix A. International Residue Limits

International Residue Limits

Note: The current US tolerances shown in the Table below do not reflect the reassessed, revised or revoked tolerances from May 2009 RED.

| Malathion *Residue Definition*: | | | | |
|---|---|---|---|---|
| US | | Canada | Mexico[2] | Codex[3] |
| 40CFR180.111(a) General (1)<br>malathion ( O,O -dimethyl dithiophosphate of diethyl mercaptosuccinate) | | diethyl mercapto-succinate S -(O,O -dimethyl phosphorodithioate) | | Plants/Livestock: malathion |
| *Commodity* | *Tolerance (ppm) /Maximum Residue Limit (mg/kg)* | | | |
| | US | Canada | Mexico[2] | Codex[3] |
| Alfalfa, forage | 135 | | | |
| Alfalfa, hay | 135 | | | |
| Almond, hulls | 50 | | | |
| Almond, postharvest | 8 | | | |
| Apple | 8 | 2 | | 0.5[3] |
| Apricot | 8 | 8 | | |
| Asparagus | 8 | 6 | | 1 |
| Avocado | 8 | 8 | | |
| Barley, grain, postharvest | 8 | 8 raw cereals | | |
| Bean, dry, seed | 8 | 2 | | 2 (dry) |
| Bean, succulent | | | | 1 beans, except broad bean and soya bean |
| Beet, garden, roots | 8 | 0.5 | | |
| Beet, garden, tops | 8 | | | |
| Beet, sugar, roots | 1 | | | |
| Beet, sugar, tops | 8 | | | |
| Blackberry | 8 | 8 | | |
| Blueberry | 8 | 8 | | 10 |
| Boysenberry | 8 | 8 | | |
| Carrot, roots | 8 | 0.5 | | |
| Chayote, fruit | 8 | | | |
| Chayote, roots | 8 | | | |
| Cherry | 8 | 6 | | 3 |
| Chestnut | 1 | | | |
| Clover, forage | 135 | | | |
| Clover, hay | 135 | | | |
| Corn, field, forage | 8 | | | |
| Corn, field, grain, postharvest | 8 | 8 raw cereals | | 0.05 maize |
| Corn, pop, grain, postharvest | 8 | 8 raw cereals | | 0.05 maize |
| Corn, sweet, forage | | | | |
| Corn, sweet, kernel plus cob with husks removed | 2 | 8 raw cereals | | 0.02 |
| Cowpea, forage | 135 | | | |
| Cowpea, hay | 135 | | | |
| Cranberry | 8 | 8 | | |
| Cucumber | 8 | 3 | | 0.2 |
| Currant | 8 | 8 | | |
| Date, dried fruit | 8 | | | |
| Dewberry | 8 | 8 | | |
| Eggplant | 8 | 0.5 | | |
| Fig | 8 | | | |

| Malathion *Residue Definition*: | | | | |
|---|---|---|---|---|
| US | | Canada | Mexico[2] | Codex[3] |
| Flax, seed | 0.1 | | | |
| Garlic, bulb | 8 | 0.5 | | |
| Gooseberry | 8 | 8 | | |
| Grape | 8 | 8<br>8 raisins | | 5[3] |
| Grapefruit | 8 | | | 7[3] citrus fruits (excluding kumquats) |
| Guava | 8 | | | |
| Hazelnut | 1 | | | |
| Hop, dried cones | 1 | | | |
| Horseradish | 8 | 0.5 horseradish roots | | |
| Kumquat | 8 | | | |
| Leek | 8 | 3 | | |
| Lemon | 8 | | | 7[3] citrus fruits (excluding kumquats) |
| Lentil, seed | 8 | 3 dry lentils | | |
| Lespedeza, hay | 135 | | | |
| Lime | 8 | | | 7[3] citrus fruits (excluding kumquats) |
| Loganberry | 8 | 8 | | |
| Lupin, seed | 8 | | | |
| Mango | 8 | | | |
| Melon | 8 | 8 | | |
| Mushroom | 8 | 8 | | |
| Nectarine | 8 | 6 | | |
| Nut, macadamia | 1 | | | |
| Oat, grain, postharvest | 8 | 8 raw cereals | | |
| Okra | 8 | 3 | | |
| Onion, bulb | 8 | 0.5 | | 1 |
| Onion, green | 8 | 3 | | 5 spring onion |
| Orange | 8 | | | 7[3] citrus fruits (excluding kumquats) |
| Papaya | 1 | 8 | | |
| Parsnip | 8 | 0.5 parsnip roots | | |
| Passionfruit | 8 | | | |
| Pea | 8 | 0.5 | | |
| Pea, field, hay | 8 | | | |
| Pea, field, vines | 8 | | | |
| Peach | 8 | 6 | | |
| Peanut, hay | 135 | | | |
| Peanut, postharvest | 8 | | | |
| Pear | 8 | 2 | | |
| Pecan | 8 | 8 | | |
| Pepper | 8 | 0.5 | | 0.1<br>1 peppers chili, dried |
| Peppermint, tops | 8 | 8 | | |
| Pineapple | 8 | 8 | | |
| Plum | 8 | 8 | | |

| Malathion *Residue Definition*: | | | | |
|---|---|---|---|---|
| US | | Canada | Mexico[2] | Codex[3] |
| Plum, prune | 8 | 8 plums | | |
| Potato | 8 | 0.5 | | |
| Pumpkin | 8 | 3 | | |
| Quince | 8 | | | |
| Radish | 8 | 0.5 radish roots | | |
| Raspberry | 8 | 8 | | |
| Rice, grain, postharvest | 8 | 8 raw cereals | | |
| Rice, wild | 8 | 8 raw cereals | | |
| Rutabagas | 8 | 0.5 rutabaga roots | | |
| Rye, grain, postharvest | 8 | 8 raw cereals | | |
| Safflower, seed | 0.2 | | | |
| Salsify, roots | 8 | 3 | | |
| Salsify, tops | 8 | | | |
| Shallot, bulb | 8 | 3 shallots | | |
| Sorghum, grain, forage | 8 | | | |
| Sorghum, grain, grain, postharvest | 8 | 8 raw cereals | | 3 sorghum |
| Soybean, forage | 135 | | | |
| Soybean, hay | 135 | | | |
| Soybean, seed | 8 | | | |
| Soybean, succulent | 8 | | | |
| Spearmint, tops | 8 | 8 | | |
| Squash, summer | 8 | 3 squash | | |
| Squash, winter | 8 | | | |
| Strawberry | 8 | 8 | | 1 |
| Sunflower, seed (Post-H) | 8 | | | |
| Sweet potato, roots | 1 | | | |
| Tangerine | 8 | | | 7[3] citrus fruits (excluding kumquats) |
| Tomato | 8 | 3 | | 0.5<br>0.01 tomato juice |
| Trefoil, forage | 135 | | | |
| Trefoil, hay | 135 | | | |
| Turnip, greens | 8 | | | 5 |
| Turnip, roots | 8 | 0.5 | | 0.2 turnip garden |
| Vegetable, brassica, leafy, group 5 | 8 | 0.5 broccoli, cauliflower, collards, kohlrabi<br><br>6 Brussels sprouts, cabbages<br>kale | | 2 mustard greens |
| Vegetables, leafy, except brassica, group 4 | 8 | 1 celery<br>6 dandelion leaves, endives, lettuce, parsley, spinach<br>0.5 Swiss chard | | 3 spinach |

| Malathion *Residue Definition*: | | | | |
|---|---|---|---|---|
| US | | Canada | Mexico[2] | Codex[3] |
| Vetch, hay | 135 | | | |
| Walnut | 8 | | | |
| Wheat, grain, postharvest | 8 | 8 raw cereals | | 10 wheat<br>25 wheat bran, unprocessed<br>0.2 wheat flour |
| 40CFR180.111(2) | | Same as above | | Same as above |
| | *Tolerance (ppm) /Maximum Residue Limit (mg/kg)* | | | |
| combined residues of the insecticide malathion (O,O-dimethyl dithiophosphate of diethyl mercaptosuccinate) and its metabolite, malaoxon (O,O-dimethyl thiophosphate of diethyl mercaptosuccinate) | US | Canada | Mexico[2] | Codex[3] |
| Barley, straw | 50 | | | |
| Corn, field, stover | 30.0 | | | |
| Cotton, undelinted seed | 20.0 | | | 20<br>13 Cotton seed oil, crude<br>13Cotton seed oil, edible |
| Grass, forage | 200 | | | |
| Grass, hay | 270 | | | |
| Oat, forage | 4.0 | | | |
| Oat, straw | 50 | | | |
| Rye, forage | 4.0 | | | |
| Rye, straw | 50 | | | |
| Watercress | 0.2 | 6 | | |
| Wheat, forage | 4.0 | | | |
| Wheat, straw | 50 | | | |
| ***MRLs with NO US Equivalent*** | | | | |
| Whole meal and flour from rye | | 2 | | |
| Whole meal and flour from wheat | | 2 | | |
| Spices, fruits and Berries | | | | 1 |
| Spices, roots, and rhizomes | | | | 0.5 |
| Spices, seeds | | | | 2 |
| | | | | |
| 40CFR 180.111(3) | *Tolerance (ppm) /Maximum Residue Limit (mg/kg)* | | | |
| Livestock: malathion (O,O-dimethyl dithiophosphate of diethyl mercaptosuccinate) | US | Canada | Mexico[2] | Codex[3] |
| Cattle, fat | 4 | | | |
| Cattle, meat[1] | 4 | | | |
| Cattle, meat byproducts[1] | 4 | | | |
| Egg | 0.1 | | | |
| Goat, fat | 4 | | | |

| Malathion *Residue Definition*: | | | | |
|---|---|---|---|---|
| US | | Canada | Mexico[2] | Codex[3] |
| Goat, meat[1] | 4 | | | |
| Goat, meat byproducts[1] | 4 | | | |
| Hog, fat | 4 | | | |
| Hog, meat[1] | 4 | | | |
| Hog, meat byproducts[1] | 4 | | | |
| Horse, fat | 4 | | | |
| Horse, meat[1] | 4 | | | |
| Horse, meat byproducts[1] | 4 | | | |
| Milk, fat | 0.5 | | | |
| Poultry, fat | 4 | | | |
| Poultry, meat[1] | 4 | | | |
| Poultry, meat byproducts[1] | 4 | | | |
| Sheep, fat | 4 | | | |
| Sheep, meat[1] | 4 | | | |
| Sheep, meat byproducts[1] | 4 | | | |
| Completed: M. Negussie; 01/20/14 | | | | |

[1]The tolerance level shall not be exceeded in any cut of meat or in any meat byproducts from cattle, goat, hog, horse, poultry, or sheep.
[2] Mexico adopts US tolerances and/or Codex MRLs for its export purposes
[3] The Committee was advised that the CXLs for apples, grapes, and citrus were based on European GAP which no longer existed. Apples- the CXLs would be considered for revocation at the next meeting; Citrus and grapes- retain the CXL until the outcome of the periodic review by JMPR (2014).
(4) Malathion may be safely used in accordance with the following conditions:
(i) It is incorporated into paper trays in amounts not exceeding 100 milligrams per square foot.
(ii) Treated paper trays are intended for use only in the drying of grape (raisins).
(iii) Total residues of malathion resulting from drying of grape on treated trays and from application to grape before harvest shall not exceed 12 parts per million on processed ready-to-eat raisins.
(5) Residues of malathion in safflower, refined oil from application to the growing safflower plant shall not exceed 0.6 parts per million.
(6) Malathion may be safely used for the control of insects during the drying of grape (raisins) in compliance with paragraph (a)(4) of this section by incorporation into paper trays in amounts not exceeding 100 milligrams per square foot.
(7) Malathion (*O,O*-dimethyl dithiophosphate of diethyl mercaptosuccinate) may be safely used in feed in accordance with the following conditions.
(i) A tolerance of 50 parts per million is established for residues of malathion in citrus, dried pulp for cattle feed, when present as the result of the application of the pesticide to bagged citrus pulp during storage. Whether or not tolerances for residues of malathion on the fresh fruit have been established under section 408 of the Act, the total residue of malathion in the citrus, dried pulp shall not exceed 50 parts per million.
(ii) A tolerance of 10 parts per million is established for malathion in nonmedicated cattle feed concentrate blocks resulting from its application as a pesticide to paper used in packaging the nonmedicated cattle feed concentrate blocks.

## Appendix B. Physiochemical Properties of Malathion and Malaoxon

| TABLE.B.1 Physicochemical Properties of Malathion | | |
|---|---|---|
| Parameter | Value | Reference |
| Molecular Weight | 330.4 | Product Chemistry Chapter (W. Smith, June 2, 1999) |
| Boiling point/range | 156-157°C | Product Chemistry Chapter (W. Smith, June 2, 1999) |
| Melting point | 2.8°C | SRC PhysProp Database |
| Density (25°C) | 1.2 | SRC PhysProp Database |
| Water solubility (25°C) | 145 ppm | Product Chemistry Chapter (W. Smith, June 2, 1999) |
| Solvent solubility (temperature not specified) | readily soluble in most alcohols, esters, aromatic solvents, and ketones, and is only slightly soluble in aliphatic hydrocarbons | Product Chemistry Chapter (W. Smith, June 2, 1999) |
| Vapor pressure (30°C) | 0.00004 mmHg | Product Chemistry Chapter (W. Smith, June 2, 1999) |
| Octanol/water partition coefficient, $\log K_{OW}$ (25°C) | 2.36 | SRC PhysProp Database |
| Half Life | Aerobic soil T½ = 3 days (used for EEC modeling) | |
| **TABLE B.2 Physicochemical Properties of Malaoxon** | | |
| Parameter | Value | Reference |
| Molecular Weight | 314.29 | Chemical Abstracts |
| Boiling Point | 114°C | |
| Melting point/range | <20°C | |
| Water solubility (22°C) | 0.5-1.0 g/100 mL | |
| Vapor pressure (10-50°C) | 2.45E-06 to 3.2E-04 torr | |
| Half Life | Aerobic soil T½ = 21 days (used for EEC modeling) | |

## Appendix C: Malathion Use Summary Table

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| Table C.1. Summary of Use Directions for Malathion. | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| **Crop** | **Application Type and Equipment** | **Formulation[1]** | **Maximum Application Rate** | **Max Seasonal Application Rate[2]** | **RTI (days)[3]** | **Max No. Apps per Season** | **REI (hours)[4]** | **PHI (days)[5]** |
| Alfalfa (field and seed crop) | Aerial, Groundboom, Chemigation, Truck Mounted ULV Sprayer | EC/LC/ Liquid | 1.25 lbs ai/A | NS | 14 | 2 | 12 | 7 |
| Amaranth | Aerial, Ground | EC | 2 lbs ai/A | NS | NS | NS | 12 | 7 |
| Apples | Ground | EC/LC | 2.23 lbs ai/A | NS | 7 | 2 | NS | 1 |
| Apricots | Aerial, Airblast, Chemigation | EC/LC | 1.5 lbs ai/A | NS | 7 | 2 | 12 | 7 |
| Around the Outside of Buildings | Aerial, Ground | EC | NS | NS | NS | NS | NS | NS |
| Arugula | Aerial, Ground | EC | 2 lbs ai/A | NS | NS | NS | 12 | 7 |
| Asparagus | Aerial, Groundboom, Chemigation | EC/EL/LC | 1.25 lb ai/A | NS | 7 | 2 | 12 | 1 |
| Avocado | Aerial, Airblast, Chemigation | EC/EL/LC | 4.75 lbs ai/A | NS | 30 | 2 | 48 | 7 |
| Barley | Aerial, Chemigation, Groundboom, Truck Mounted ULV Sprayer, | EC/EL/LC/ ULV-C | 0.61 lb ai/A<br>1.25 lb ai/A | NS | 7 | 2 | 12 | 7 |
| Beans (snap, lima, dry, and succulent) | Aerial, Truck Mounted ULV Sprayer, | EC/EL/LC/ ULV-C | 0.61 lb ai/A<br>1.5 lb ai/A | NS | 7 | 2 | 12 | 1 |
| Beets (table, garden) | Aerial, Groundboom, Chemigation | EC/EL/LC | 1.25 lb ai/A | NS | 7 | 3 | 12 | 7 |
| Blueberry (high and low bush) | Aerial, Airblast, Chemigation, Groundboom, Truck Mounted ULV Sprayer, | EC/EL/LC/ ULV-C | 0.77 lb ai/A to 1.25 lb ai/A | NS | 5-10 | 3 | 12 | 1 |
| Brambles | Aerial, Ground | EC | 1.88 | NS | 5 | 3 | 12 | 1 |
| Broccoli (Chinese, rabb) | Aerial, Chemigation, Groundboom | EC/EL/LC/ Liquid | 1.25 lb ai/A | NS | 2-7 | 2 | 48 | 3 |
| Brussel sprouts | Aerial, Chemigation, Groundboom | EC/EL/LC/ Liquid | 1.25 lb ai/A | NS | 7 | 2 | 48 | 2-7 |
| Cabbage | Aerial, Chemigation, Groundboom | EC/EC/LC/ Liquid | 1.25 lb ai/A | NS | 7 | 6 | 48 | 7 |

| Table C.1. Summary of Use Directions for Malathion. | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| **Crop** | **Application Type and Equipment** | **Formulation[1]** | **Maximum Application Rate** | **Max Seasonal Application Rate[2]** | **RTI (days)[3]** | **Max No. Apps per Season** | **REI (hours)[4]** | **PHI (days)[5]** |
| Caneberries | Aerial, Ground | EC/LC | 2.0 lb ai/A | NS | 7 | 3 | 12 | 1 |
| Cantaloupe | Aerial, Chemigation, Groundboom | EC/EL/LC | 1.0 lb ai/A | NS | 7 | 2 | 12 | 1 |
| Carrots | Aerial, Groundboom, Chemigation | EC/EL/LC | 1.25 lb ai/A | NS | 7 | 2 | 24 | 7 |
| Cauliflower | Aerial, Chemigation, Groundboom | EC/EL/LC | 1.25 lb ai/A | NS | 7 | 2 | 48 | 2-7 |
| Cavalo Broccolo | Aerial, Chemigation, Groundboom | EC/LC | 1.25 lb ai/A | NS | 7 | 2 | 48 | 2 |
| Celery | Aerial, Groundboom, Chemigation | EC/EL/LC | 1.5 lb ai/A | NS | 7 | 2 | 24 | 7 |
| Celtuce | Aerial, Groundboom | EC | 2.0 lb ai/A | NS | NS | NS | 12 | 7 |
| Chayote fruit | Aerial, Groundboom, Chemigation | EC | 1.75 lb ai/A | NS | 7 | 2 | 24 | 1 |
| Chayote root | Aerial, Groundboom, Chemigation | EC | 1.56 lb ai/A | NS | 7 | 2 | 24 | 1 |
| Cherries (tart, sweet) | Aerial, Airblast, Chemigation | EC/EL/LC/Liquid | 1.22 lb ai/A<br>1.75 lb ai/A | NS | 3-14 | 4 - 6 | 12 | 1-3 |
| Chervil | Aerial, Ground | EC | 2.0 lb ai/A | NS | NS | NS | 12 | 7 |
| Chestnut | Aerial, Airblast, Chemigation | EC | 2.5 lb ai/A | NS | 7 | 3 | 24 | 2 |
| Chinese Cabbage | Aerial, Groundboom | EC/LC | 1.25 lb ai/A | NS | 7 | 2 | 24-48 | 7 |
| Chinese Mustard | Aerial, Groundboom | EC/LC | 1.0 lb ai/A to 1.25 lb ai/A | NS | 7 | 3 | 48 | 7 |
| Christmas tree plantations | Aerial, Airblast, Chemigation, Truck Mounted ULV Sprayer, Manually/Mechanically Pressurized Handwands | EC/LC | 0.94 lb ai/A<br>3.2 lb ai/A | NS | NS | NS | 12 | NA |
| Chrysanthemum | Aerial, Ground | EC | 2.0 lb ai/A | NS | NS | NS | 12 | 7 |

| Table C.1. Summary of Use Directions for Malathion. | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| **Crop** | **Application Type and Equipment** | **Formulation[1]** | **Maximum Application Rate** | **Max Seasonal Application Rate[2]** | **RTI (days)[3]** | **Max No. Apps per Season** | **REI (hours)[4]** | **PHI (days)[5]** |
| Citrus - non-bearing (Excluding CA) | Aerial, Airblast, Chemigation | EC/EL | 4.5 lb ai/A | NS | NS | 1<br>2 | 72<br>12 | 7 |
| Citrus - non-bearing (CA Only) | Aerial, Airblast, Chemigation | EC/EL | 7.5 lb ai/A | NS | NS | 1 | 72 | 7 |
| Citrus Fruits (Excluding CA) | Aerial, Airblast, Chemigation | EC/EL/LC/ULV | 4.5 lb ai/A<br>0.16 lb ai/A | NS | NS<br>30 | 1 | 72 | 7 |
| Citrus Fruits (CA Only) | Aerial, Airblast, Chemigation | EC/LC | 7.5 lb ai/A | NS | NS | 1 | 72 | 7 |
| Clover, Clover Seed | Aerial, Groundboom, Chemigation, Truck Mounted ULV Sprayer | EC/EL/LC/ ULV-C | 1.25 lb ai/A | NS | 14 | NS | 12 | 0 |
| Collards | Aerial, Groundboom, Chemigation | EC | 1.0 lb ai/A | NS | 7 | 3 | 12 | 7 |
| Commodities (wheat, corn, oats, barley, rye) | Rake in | Dust | NS | NS | 60 | 3 | NS | NS |
| Corn (field, sweet, pop) | Aerial, Groundboom, Chemigation, Truck-Mounted ULV Sprayer | EC/EL/LC/ ULV-C | 0.61 lb ai/A<br>1.0 lb ai/A | NS | 5<br>7 | 2 | 72 – detasseling<br>12 – other activities | 5<br>7 |
| Corn Salad | Aerial, Ground | EC | 2.0 lb ai/A | NS | NS | NS | 12 | 5 |
| Cotton | Aerial, Groundboom, Truck-Mounted ULV Sprayer | EC/EL/LC/ ULV-C/ Liquid | 1.22 lb ai/A<br>2.5 lb ai/A | NS | 7 - 8 | 3 | 48 | 7 - 21 |
| Cucumber | Aerial, Groundboom, Chemigation | EC/LC | 1.75 lb ai/A | NS | 7 | 2 | 24 | 1 |
| Cull Dumps<br>Cull Piles | Backpack, Mechanically/Manually-pressurized Handwands | EC | 299 – 326.7 lb ai/A | NS | NS | NS | NS | NS |
| Currant | Aerial, Groundboom | EC/LC | 1.25 lb ai/A | NS | 7 | 3 | 12 | 1 |

| Table C.1. Summary of Use Directions for Malathion. | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| **Crop** | **Application Type and Equipment** | **Formulation[1]** | **Maximum Application Rate** | **Max Seasonal Application Rate[2]** | **RTI (days)[3]** | **Max No. Apps per Season** | **REI (hours)[4]** | **PHI (days)[5]** |
| Dandelion | Aerial, Groundboom | EC/LC | 1.25 lb ai/A | NS | 7 | 2 | 24 | 7 |
| Dock (sorrel) | Aerial, Groundboom | EC | 2.0 lb ai/A | NS | NS | NS | 12 | 7 |
| Eggplant | Aerial, Groundboom | EC/EL/LC | 1.56 lb ai/A | NS | 5-7 | 2 | 12-24 | 3 |
| Endive (escarole) | Aerial, Groundboom | EC/EL/LC | 1.25 lb ai/A | NS | 7 | 2 | 24 | 7 |
| Fence Rows/Hedge Rows | Mechanically Pressurized Handgun | EC/ULV-C | 0.24 lb ai/A to 0.93 lb ai/A | NS | NS | NS | 12 | NS |
| Figs | Aerial, Airblast | EC/EL/LC | 2.0 lb ai/A | NS | 5 | 2 | 12-24 | 5 |
| Flax | Aerial, Groundboom | EC/LC | 0.5 lb ai/A | NS | 7 | 3 | 12 | 52 |
| Flies | Ground | EC/EL/LC | NS | NS | NS | NS | NS | NS |
| Florence Fennel | Aerial, Ground | EC | 2.0 lb ai/A | NS | NS | NS | 12 | 7 |
| Garlic | Aerial, Groundboom, Chemigation | EC/EL/LC | 1.56 lb ai/A | NS | 7 | 3 | 24 | 3 |
| Gooseberry | Aerial, Groundboom | EC | 2.0 lb ai/A | NS | NS | NS | 12 | 3 |
| Grain Storage Facilities (empty) | Ground | EC/EL/LC | NS | NS | NS | NS | 12 | NS |
| Grapes (raisin, table, wine, vineyard) | Aerial, Airblast, Groundboom | EC/EL/LC | 1.88 lb ai/A | NS | 14 | 2 | 72-girdling and tying 24-all other activities | 3 |
| Grass (forage, hay, bermuda, rangeland) | Aerial, Groundboom, Chemigation | EC/EL/LC | 1.25 lb ai/A | NS | NS | NS | 12 | 0-7 |
| Guava | Aerial, Airblast | EC | 1.25 lb ai/A | NS | 3 | 13 | 12 | 2 |
| Honeydew | Aerial, Ground | EC/EL | 0.94 lb ai/A 0.78 lb ai/A | NS | 7 | 2 | 12 | 1-2 |
| Hops | Aerial, Airblast, Groundboom, | EC/EL/LC | 0.63 lb ai/A | NS | 7 | 3 | 12 | 10 |

| Table C.1. Summary of Use Directions for Malathion. | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| **Crop** | **Application Type and Equipment** | **Formulation[1]** | **Maximum Application Rate** | **Max Seasonal Application Rate[2]** | **RTI (days)[3]** | **Max No. Apps per Season** | **REI (hours)[4]** | **PHI (days)[5]** |
| Horseradish | Aerial, Groundboom, Chemigation | EC/EL/LC | 1.25 lb ai/A | NS | 7 | 3 | 24 | 7 |
| Kale | Aerial, Groundboom, Chemigation | EC/EL/LC/ Liquid | 1.0 lb ai/A | NS | 5-7 | 3 | 12 | 7 |
| Kohlrabi | Aerial, Groundboom | EC/EL/LC | 1.25 lb ai/A | NS | 7 | 2 | 24 | 7 |
| Kumquat | Aerial, Airblast, Truck-Mounted ULV Sprayer | EC/LC | 0.18 lb ai/A<br>4.5 lb ai/A | NS | 30 | 1 | 48 | 7 |
| Lawns | Groundboom, (spot) | NS | NS | NS | 10 | NS | NS | NS |
| Leeks | Aerial, Groundboom, Chemigation | EC/LC | 1.56 lb ai/A | NS | 7 | 2 | 24 | 3 |
| Lemons (FL only) | Aerial, Airblast, Truck-Mounted ULV-Sprayer | EC | 1.0 lb ai/A<br>1.25 lb ai/A | NS | NS | 1 | 12 | 7 |
| Lentils | Aerial, Groundboom | EC | 1.5 lb ai/A | NS | NS | NS | 12 | 3 |
| Lespedeza (plant, seed) | Aerial, Truck-Mounted ULV Sprayer | EC/EL/LC | 0.61 lb ai/A<br>1.25 lb ai/A | NS | 14 | NS | 12 | 0 |
| Lettuce (head, leaf) | Aerial, Airblast, Groundboom | EC/EL/LC | 1.88 lb ai/A | NS | 5 - leaf<br>6 - head | 2 | 24 | 14 |
| Lupine (plant, seed) | Aerial, Truck-Mounted ULV Sprayer | EC/LC | 0.61 lb ai/A | NS | NS | 1 | 12 | 1 |
| Macadamia Nut | Aerial, Airblast, Chemigation | EC/LC | 0.94 lb ai/A | NS | 7 | 6 | 12 | 1 |
| Mango | Aerial, Airblast, Groundboom, Chemigation | EC/LC | 0.94 lb ai/A | NS | 7 | 10 | 12 | 1 |
| Melons | Aerial, Groundboom, Chemigation | EC/EL/LC | 1.0 lb ai/A | NS | 7 | 2 | 12 | 1 |
| Mint | Aerial, Groundboom, Chemigation | EC/LC | 0.94 lb ai/A | NS | 7 | 3 | 12 | 7 |
| Mizuna | Aerial, Ground | EC/LC | 1.0 lb ai/A | NS | 5-7 | 2-3 | 12 | 7 |
| Mosquitoes | Aerial, Groundboom | EC/EL/LC | 0.23 lb ai/A | NS | NS | NS | NS | NS |

| Table C.1. Summary of Use Directions for Malathion. | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| **Crop** | **Application Type and Equipment** | **Formulation[1]** | **Maximum Application Rate** | **Max Seasonal Application Rate[2]** | **RTI (days)[3]** | **Max No. Apps per Season** | **REI (hours)[4]** | **PHI (days)[5]** |
| Mushrooms | Backpack, Handheld Fogger, Manually/ Mechanically Pressurized Handgun | EC/EL/LC | 1.7 lb ai/A | NS | 3-7 | 3-4 | 12 | 1 |
| Muskmelons | Ground | EL | 0.94 | NS | 7 | 2 | 12 | 1 |
| Mustard (greens, spinach) | Aerial, Groundboom, Chemigation | EC/EL/LC/ Liquid | 1.0 lb ai/A | NS | 5-7 | 3 | 12-48 | 7 |
| Nectarines | Aerial, Airblast, Chemigation | EC | 3.0 lb ai/A | NS | 7 | 3 | 24 | 7 |
| Non-agricultural Uncultivated Areas/Soil | Aerial, Groundboom, Backpack, Manually/ Mechanically Pressurized Handwand | LC/ULV-C | 0.93 lb ai/A | NS | NS | NS | NS | NS |
| Oats | Aerial, Groundboom, Chemigation, Truck Mounted ULV Sprayer | EC/EL/LC/ ULV-C | 0.61 lb ai/A<br>1.0 lb ai/A | NS | 7 | 2 | 12 | 7 |
| Okra | Aerial, Groundboom, Chemigation | EC/EL/LC | 1.2 lb ai/A | NS | 7 | 5 | 12 | 1 |
| Onions (bulb and green) | Aerial, Groundboom, Chemigation | EC/EL/LC | 1.56 lb ai/A | NS | 7 | 2 | 12 | 3 |
| Orach | Aerial, Ground | EC | 2.0 lb ai/A | NS | NS | NS | 12 | 7 |
| Ornamentals in outdoor nurseries | Aerial, Airblast, Chemigation, Handheld; Soil injectors | EC/EL/LC/ Liquid | 2.0 lb ai/A<br>2.5 lb ai/A<br>4.4 lb ai/A | NS | 10<br>NS | 2<br>NS | 12<br>NS | NS |
| Papaya | Aerial, Airblast | EC/EL/LC | 1.25 lb ai/A | NS | 3 | 8 | 12 | 1 |
| Parsley | Aerial, Groundboom, Chemigation | EC/EL/LC | 1.25 lb ai/A<br>1.5 lb ai/A | NS | 7 | 2 | 24 | 7 |
| Parsnip | Aerial, Groundboom, Chemigation | EC/EL/LC | 1.25 lb ai/A | NS | 7 | 3 | 24 | 7 |
| Passion Fruit | Aerial, Airblast, Groundboom, Chemigation | EC/LC | 1.0 lb ai/A | NS | 7 | 8 | 12 | 3 |

| Table C.1. Summary of Use Directions for Malathion. | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| **Crop** | **Application Type and Equipment** | **Formulation[1]** | **Maximum Application Rate** | **Max Seasonal Application Rate[2]** | **RTI (days)[3]** | **Max No. Apps per Season** | **REI (hours)[4]** | **PHI (days)[5]** |
| Pasture and Rangeland | Aerial, Ground | EC/EL/LC/ ULV-C | 0.92 lb ai/A | NS | 7 | NS | 12 | 0-3 |
| Peaches | Aerial, Airblast, Chemigation | EC/LC/ | 3.0 lb ai/A | NS | 11-30 | 3 | 24 | 7-21 |
| Pears | Aerial, Airblast, Chemigation | EC/LC | 1.25 lb ai/A | NS | 7-11 | 2 | 12 | 1-3 |
| Peas (dry, succulent, green) | Aerial, Groundboom, Chemigation | EC/LC | 1.0 lb ai/A | NS | 7 | 2 | 12 | 3 |
| Pecans | Aerial, Airblast, Chemigation | EC/LC | 2.5 lb ai/A | NS | 7 | 2 | 24 | 7 |
| Peppers, Bell Peppers | Aerial, Groundboom | EC/EL/LC | 1.56 lb ai/A | NS | 5 | 2 | 12 | 3 |
| Pine Seed Orchards | Aerial, Airblast, Backpack, Chemigation, Handgun, ULV Sprayer | EC/LC | 3.2 lb ai/A | NS | 7-10 | 2 | 12 | NS |
| Pineapples | Aerial, Groundboom, Chemigation | EC/LC | 2.0 lb ai/A | NS | 7 | 3 | 24 | 7 |
| Potatoes | Aerial, Groundboom, Chemigation | EC/EL/LC/ Liquid | 1.56 lb ai/A | NS | 7 | 2 | 12 | 0 |
| Pumpkins | Aerial, Groundboom, Chemigation | EC/EL/LC | 1.0 lb ai/A | NS | 7 | 2 | 12 | 1-3 |
| Purslane (garden) | Aerial, Ground | EC | 2.0 lb ai/A | NS | NS | NS | 12 | 7 |
| Radish, Rutabaga | Aerial, Groundboom, Chemigation | EC/EL/LC | 1.0 lb ai/A | NS | 7 | 3 | 12 | 7 |
| Rape Greens | Aerial, Ground | EC/LC | 1.25 lb ai/A<br>2.5 lb ai/A | NS | 7 | 2 | 48<br>12 | 2<br>7 |
| Rice, Wild Rice | Aerial, Groundboom, Chemigation, Truck Mounted ULV Sprayer | EC/EL/LC | 0.61 lb ai/A<br>1.25 lb ai/A | NS | 7 | 2 | 12 | 7 - 14 |
| Rye | Aerial, Groundboom, Chemigation, Truck Mounted ULV Sprayer | EC | 0.61 lb ai/A<br>1.0 lb ai/A | NS | 7<br>3 | NS<br>3 | 12 | 7 |

| Table C.1. Summary of Use Directions for Malathion. | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| **Crop** | **Application Type and Equipment** | **Formulation[1]** | **Maximum Application Rate** | **Max Seasonal Application Rate[2]** | **RTI (days)[3]** | **Max No. Apps per Season** | **REI (hours)[4]** | **PHI (days)[5]** |
| Salsify | Aerial, Groundboom, Chemigation | EC | 1.25 lb ai/A | NS | 7 | 3 | 24 | 7 |
| Shallot | Aerial, Groundboom, Chemigation | EC | 0.98 lb ai/A<br>1.56 lb ai/A | NS | 7 | 2 | 24 | 3 |
| Slash Pine | Aerial, Ground | EC/LC | NS | NS | 10 | 2 | 12 | NS |
| Sorghum | Aerial, Groundboom, Chemigation, Truck Mounted ULV Sprayer | EC/EL/LC/ ULV-C | 0.61 lb ai/A<br>1.0 lb ai/A | NS | 7 | 2 | 12 | 7 |
| Spinach | Aerial, Groundboom, Chemigation | EC/EL/LC | 1.0 lb ai/A | NS | 7 | 2 | 12 | 7 |
| Squash, summer | Aerial, Groundboom, Chemigation | EC/EL/LC/ Liquid | 1.75 lb ai/A | NS | 7 | 2-3 | 24 | 1 |
| Squash, winter | Aerial, Groundboom, Chemigation | EC/EL/LC/ Liquid | 1.0 lb ai/A | NS | 7 | 2-3 | 12 | 1 |
| Strawberries | Aerial, Groundboom, Chemigation | EC/EL/LC | 2.0 lb ai/A | NS | 7 | 4 | 12 | 3 |
| Sweet Potatoes | Aerial, Groundboom, Chemigation | EC/EL/LC | 1.56 lb ai/A | NS | 7 | 2 | 12 | 0-3 |
| Swiss Chard | Aerial, Groundboom, Chemigation | EC/EL/LC | 1.0 lb ai/A | NS | 7 | 2 | 12 | 14 |
| Tangerines | Aerial, Airblast, Chemigation, Truck-Mounted ULV Sprayer | EC | 1.25 lb ai/A<br>1.50 – 4.5 lb ai/A<br>0.18 lb ai/A | NS | NS | 1 | 72 | 7 |
| Tomatoes | Aerial, Groundboom | EC/EL/LC/ Liquid | 1.56 lb ai/A | NS | 5-7 | 4 | 12 | 1-3 |
| Trefoil (birdsfoot) | Aerial, Groundboom, Chemigation, Truck Mounted ULV Sprayer | EC | 1.25 lb ai/A | NS | NS | 14 | 12 | 0 |
| Turnip (roots, greens) | Aerial, Groundboom, Chemigation | EC/EL/LC | 1.25 lb ai/A | NS | 5-7 | 3 | 12 - 24 | 1-7 |

| Table C.1. Summary of Use Directions for Malathion. | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| **Crop** | **Application Type and Equipment** | **Formulation[1]** | **Maximum Application Rate** | **Max Seasonal Application Rate[2]** | **RTI (days)[3]** | **Max No. Apps per Season** | **REI (hours)[4]** | **PHI (days)[5]** |
| Vetch | Aerial, Groundboom, Chemigation | EC/SC/Liquid | 1.25 lb ai/A | NS | 14 | NS | 12 | 0 |
| Walnuts | Aerial, Airblast, Chemigation | EC/LC | 2.5 lb ai/A | NS | 7 | 3 | 24 | 7 |
| Watercress | Aerial, Groundboom | EC/LC | 1.25 lb ai/A | NS | 3 | 5 | 12-24 | 3 |
| Watermelon | Aerial, Groundboom, Chemigation | EC/EL/LC | 1.0 lb ai/A<br>1.5 lb ai/A | NS | 7 | 2-4 | 12 | 1 |
| Wheat (spring, winter) | Aerial, Groundboom, Chemigation, Truck-Mounted ULV Sprayer | EC/EL/LC/ ULV-C | 0.61 lb ai/A<br>1.0 lb ai/A | NS | 7 | 2 | 12 | 7 |
| Yams | Aerial, Groundboom, Chemigation | EC | 1.56 lb ai/A | NS | 7 | 2 | 24 | 0 |

1. EC = Emulsifiable Concentrate, EL = Emulsifiable Liquid, LC = Liquid Concentrate, ULV-C = ULV Concentrate
2. NS = Not Stated
3. RTI = Re-Treatment Interval
4. PHI = Pre-Harvest Interval
5. REI = Re-Entry Interval

| Table C.2. Summary of Use Directions for Malathion (non-occupational use rates) | | | | | | |
|---|---|---|---|---|---|---|
| **Crop** | **Label [EPA Reg No]** | **Formulation[1]** | **Maximum Application Rate** | **Max Seasonal Application Rate[2]** | **RTI (days)[3]** | **Max No. Apps per Season** |
| Apples | [4-99] | EC/LC | 2.23 lbs ai/A | NS | 7 | 2 |
| Apricots | [239-739;4-122;46515-19] | EC/LC | 2.23 lbs ai/A | NS | 7 | 2 |
| Asparagus | [4-99] | EC/EL/LC | 2.23 lb ai/A | NS | 7 | 2 |
| Avocado | [829-175] | EC/EL/LC | NS | NS | 30 | 2 |
| Beans (snap, lima, dry, and succulent) | [4-99; 239-739; 28293-123; 4-412; 46515-19] | EC/EL/LC | 1.1-1.28 lb ai/A | NS | 7 | 2 |
| Beans (dry and succulent) | [33955-394] | LC | 1.48 lbs ai/A | NS | | |
| Beets | [499; 239-739] | EC/LC | 2.23 lb ai/A | NS | 7 | 3 |
| Beets (garden) | [4-412] | EL | 2.2 lb ai/A | NS | 7 | 3 |
| Blueberry (high and low bush) | [4-99] | EC | 2.23 lb ai/A | NS | 5-10 | 3 |
| Broccoli (Chinese, rabb) | [4-99; 239-739; 33955-394; 4-412; 46515-19; 829-282] | EC/LC | 1.24- 2.2 lb ai/A | NS | 7 | 2 |
| Brussel sprouts | [4-99; 239-739; 4-412] | EC/EL/LC/ Liquid | 1.86- 2.2 lb ai/A | NS | 7 | 2 |
| Cabbage | [4-99; 239-739; 28293-123; 33955-394; 4-412; 46515-19; 7401-10; 829-282] | EC/EC/LC/ Liquid | 1.0- 2.6 lb ai/A | NS | 7 | 6 |
| Caneberries | [4-99] | EC | 3.7 lb ai/A | NS | 7 | 3 |
| Cantaloupe | [239-739; 829-282] | EC/EL/LC | 1.0 lb ai/A | NS | 7 | 2 |
| Carrots | [4-99; 4-412] | EC/EL/LC | 2.2 lb ai/A | NS | 7 | 2 |
| Cauliflower | [4-99; 239-739; 4-412] | EC/EL/LC | 1.8-2.2 lb ai/A | NS | 7 | 2 |
| Celery | [4-99; 239-739] | EC/EL/LC | 1.0-2.2 lb ai/A | NS | 7 | 2 |
| Cherries (tart, sweet) | [4-99; 829-282; 239-739; 4-122; 46515-19] | EC/EL/LC/Liquid | 1.0-3.0 lbs ai/A | NS | 3 | 4 |

| Table C.2. Summary of Use Directions for Malathion (non-occupational use rates) | | | | | | |
|---|---|---|---|---|---|---|
| **Crop** | **Label [EPA Reg No]** | **Formulation[1]** | **Maximum Application Rate** | **Max Seasonal Application Rate[2]** | **RTI (days)[3]** | **Max No. Apps per Season** |
| Citrus | [4-99; 239-739; 46515-19] | EC/EL | 1.0-2.23 lb ai/A | NS | 7 | 1 |
| Collards | [4-99; 239-739; 4-412] | EC/EL/LC | 1.6-1.86 lb ai/A | NS | 7 | 3 |
| Corn (field, sweet, pop) | [4-99] | EC | 1.86 lb ai/A | NS | 5 | 2 |
| Cucumber | [4-99; 239-739; 28293-123; 4-412; 829-282] | EC/LC | 1.0-3.4 lb ai/A | NS | 7 | 2 |
| Dandelion | [4-99] | EC/LC | 2.23 lb ai/A | NS | 7 | 2 |
| Eggplant | [4-99; 239-739; 4-412; 829-282] | EC/EL/LC | 0.52- 3.0 lb ai/A | NS | 5-7 | 2 |
| Endive (escarole) | [239-739] | EC/EL/LC | 2.23 lbs ai/A | NS | 7 | 2 |
| Garlic | [239-739] | EC/EL/LC | NS | NS | 7 | 3 |
| Grapes (raisin, table, wine, vineyard) | [239-739; 4-122; 46515-19; 829-282] | EC/EL/LC | 1.1 lb ai/A | NS | 14 | 2 |
| Kale | [4-99; 239-739; 28293-123; 3355-394; 4-412; 46515-19; 829-282] | EC/EL/LC/ Liquid | 1.5- 2.1 lb ai/A | NS | 5-7 | 3 |
| Kohlrabi | [4-99] | EC/EL/LC | 2.23 lb ai/A | NS | 7 | 2 |
| Kumquat | [4-99; 829-282] | EC/LC | 2.23 lb ai/A | NS | 30 | 1 |
| Leeks | [239-739] | EC/LC | NS | NS | 7 | 2 |
| Lemons (FL only) | [829-282] | EC | 1.0 lb ai/A | NS | NS | 1 |
| Lettuce (head, leaf) | [4-99; 28293-123, 4-412] | EC/EL/LC | 3.3-3.8 lb ai/A | NS | 6 | 2 |
| Mango | [239-739] | EC/LC | NS | NS | 7 | 10 |
| Melons | [4-99; 239-739] | EC/EL/LC | 1.86 lb ai/A | NS | 7 | 2 |
| Mosquitoes | [4-99; 33955-394; 829-282] | EC/EL/LC | 0.43 lb ai/A | NS | NS | NS |
| Mustard (greens, spinach) | [4-99; 239-739; 33955-394; 829-282] | EC/EL/LC/ Liquid | 1.5-1.86 lb ai/A | NS | 7 | 3 |
| Okra | [239-739] | EC/EL/LC | NS | NS | 7 | 5 |
| Onions (bulb and green) | [4-99; 239-739; 4-412; 829-282] | EC/EL/LC | 1.0- 3.0 lb ai/A | NS | 7 | 2 |

| Table C.2. Summary of Use Directions for Malathion (non-occupational use rates) | | | | | | |
|---|---|---|---|---|---|---|
| **Crop** | **Label [EPA Reg No]** | **Formulation[1]** | **Maximum Application Rate** | **Max Seasonal Application Rate[2]** | **RTI (days)[3]** | **Max No. Apps per Season** |
| Ornamentals in outdoor nurseries | [4-99; 239-739; 33955-394; 4-412; 45385-43; 46515-10; 7401-10; 829-282] | EC/EL/LC/ Liquid | 4.4 lb ai/A | NS | 10 | 2 |
| Outdoor Residential areas | [10088-56; 239-739; 28293-123; 4-122; 45385-43; 829-175] | EC/EL/LC/ | 5.1 lbs ai/A | NS | 7-14 | 2-6 |
| Parsley | [4-99] | EC/EL/LC | 2.23 lb ai/A | NS | 7 | 2 |
| Peaches | [4-99; 239-739; 4-122; 46515-19; 7401-10; 829-282] | EC/LC | 1.0- 4.5 lb ai/A | NS | 11 | 3 |
| Pears | [4-99; 239-739; 7401-10; 829-282] | EC/LC | 1.0- 2.23 lb ai/A | NS | 5 | 2 |
| Peas (dry, succulent, green) | [239-739; 33955-394; 46515-19] | EC/LC | 1.5 lb ai/A | NS | 7 | 2 |
| Pecans | [829-282] | EC/LC | 1.0 lb ai/A | NS | 7 | 2 |
| Peppers, Bell Peppers | [4-99; 239-739; 4-412; 829-282] | EC/EL/LC | 0.52- 3.0 lb ai/A | NS | 5 | 2 |
| Potatoes | [4-99; 239-739; 33955-394; 46515-19; 7401-10; 829-282] | EC/EL/LC/ Liquid | 0.52-3.0 lb ai/A | NS | 7 | 2 |
| Pumpkins | [4-99; 239-739] | EC/EL/LC | 1.8 lb ai/A | NS | 7 | 2 |
| Radish | [239-739; 46515-19; 829-282] | EC/EL/LC | 0.52- 1.0 lb ai/A | NS | 7 | 3 |
| Rice, Wild Rice | [829-282] | EC/EL/LC | 1.1 lb ai/A | NS | 7 | 2 |
| Rutabaga | [4-99; 239-739] | EC/LC | 1.86 lbs ai/A | NS | 7 | 3 |
| Shallot | [239-739] | LC | NS | NS | 7 | 2 |
| Spinach | [4-99, 239-739, 28293-123; 4-412] | EC/EL/LC | 1.6 -3.0 lb ai/A | NS | 7 | 2 |
| Squash, summer | [4-99; 28293-123; 4-412; 46515-19; 829-282] | EC/EL/LC/ Liquid | 3.0-3.4 lb ai/A | NS | 7 | 3 |
| Squash, winter | [4-99; 28293-123; 4-412; 46515-19; 829-282] | EC/EL/LC/ Liquid | 1.8-2.1 lb ai/A | NS | 7 | 3 |
| Standing Water | [10088-56] | LC | 0.51 lbs ai/A | NS | NS | NS |

| Table C.2. Summary of Use Directions for Malathion (non-occupational use rates) | | | | | | |
|---|---|---|---|---|---|---|
| **Crop** | **Label [EPA Reg No]** | **Formulation[1]** | **Maximum Application Rate** | **Max Seasonal Application Rate[2]** | **RTI (days)[3]** | **Max No. Apps per Season** |
| Strawberries | [239-739; 4-122; 46515-19; 829-282] | EC/EL/LC | 0.52-1.6 lb ai/A | NS | 7 | 4 |
| Sweet Potatoes | [4-99; 239-739] | EC/EL/LC | 3.0 lb ai/A | NS | 7 | 2 |
| Swiss Chard | [4-99; 239-739] | EC/EL/LC | 1.8 lb ai/A | NS | 7 | 2 |
| Tomatoes | [4-99; 239-739; 33955-394; 4-412; 46515-19; 7401-10; 829-282] | EC/EL/LC/ | 1.48- 3.0 lb ai/A | NS | 5-7 | 4 |
| Turnip (roots, greens) | [4-99; 239-739] | EC/EL/LC | 1.24- 2.23 lb ai/A | NS | 5-7 | 3 |
| Watercress | [4-99] | EC/LC | 1.86 lb ai/A | NS | 3 | 5 |
| Watermelon | [4-99] | EC/EL/LC | 2.23 lb ai/A | NS | 7 | 2-4 |

1. EC = Emulsifiable Concentrate, EL = Emulsifiable Liquid, LC = Liquid Concentrate
2. NS = Not Stated
3. RTI = Re-Treatment Interval

## Appendix D. Toxicology Data Requirements, Toxicity Profiles, and Summary of OPP's Cholinesterase Policy & Use of BMD Modeling

### D.1 Toxicology Data Requirement

| Test | Technical | |
|---|---|---|
| | Required | Conducted |
| 870.1100 Acute Oral Toxicity | yes | yes |
| 870.1200 Acute Dermal Toxicity | yes | yes |
| 870.1300 Acute Inhalation Toxicity | yes | yes |
| 870.2400 Primary Eye Irritation | yes | yes |
| 870.2500 Primary Dermal Irritation | yes | yes |
| 870.2600 Dermal Sensitization | yes | yes |
| 870.3100 Oral Subchronic (rodent) | yes | yes |
| 870.3150 Oral Subchronic (non-rodent) | yes | yes |
| 870.3200 21/28-Day Dermal | yes | yes |
| 870.3250 90-Day Dermal | no | no |
| 870.3465 90-Day Inhalation | yes | yes |
| 870.3700a Developmental Toxicity (rodent) | yes | yes |
| 870.3700b Developmental Toxicity (non-rodent) | yes | yes |
| 870.3800 Reproduction | yes | yes |
| 870.4100a Chronic Toxicity (rodent) | yes | yes |
| 870.4100b Chronic Toxicity (non-rodent) | yes | yes |
| 870.4200a Oncogenicity (rat) | yes | yes |
| 870.4200b Oncogenicity (mouse) | yes | yes |
| 870.4300 Chronic/Oncogenicity | yes | yes |
| 870.5100 Mutagenicity—Gene Mutation (bacterial) | yes | yes |
| 870.5300 Mutagenicity—Gene Mutation (mammalian) | yes | yes |
| 870.5375 Mutagenicity—Structural Chromosomal Aberrations | yes | yes |
| 870.5395 Mutagenicity—Other Genotoxic Effects | yes | yes |
| 870.5500 Mutagenicity—Other Genotoxic Effects | yes | yes |
| 870.6100a Acute Delayed Neurotoxicity (hen) | yes | yes |
| 870.6100b 90-Day Neurotoxicity (hen) | no | no |
| 870.6200a Acute Neurotoxicity Screening Battery (rat) | yes | yes |
| 870.6200b 90-Day Neurotoxicity Screening Battery (rat) | yes | yes |
| 870.6300 Developmental Neurotoxicity | yes | yes |
| 870.7485 General Metabolism | yes | yes |
| 870.7600 Dermal Penetration | no | yes |
| 870.7800 Immunotoxicity | yes | yes |

## D.2 Toxicity Profiles

| Acute Toxicity Profile for Malathion | | | | |
|---|---|---|---|---|
| **Guideline Number** | **Study Type** | **MRID(s)** | **Results** | **Toxicity Category** |
| 870.1100 | Acute oral [Rat] | 00159876 | $LD_{50}$= 5400(M)/5700(F) mg/kg | IV |
| 870.1200 | Acute dermal [Rat] | 00159877 | $LD_{50}$ >2000 mg/kg (M)(F) | III |
| 870.1300 | Acute inhalation [Rat] | 00159878 | $LC_{50}$> 5.2 mg/L (M)(F) | IV |
| 870.2400 | Acute eye irritation [Rabbit] | 00159880 | Slight conjunctival irritation; Clear by 7 days | III |
| 870.2500 | Acute dermal irritation [Rabbit] | 00159879 | Slight dermal irritation (PIS=1.1) | IV |
| 870.2600 | Skin sensitization [Guinea pig] | 00159881 | Not a skin sensitizer | NA |

| Subchronic, Chronic and Other Toxicity Profile for Malathion | | |
|---|---|---|
| **Guideline Number/ Study Type** | **MRID(s)/ Year Doses/Classification** | **Results** |
| 870.3200 - 21-Day dermal toxicity (NZ rabbit) (94%, a.i.) | MRID 41054201 (1989) Doses: 0, 50, 300, 1000 mg/kg/day Acceptable/ guideline | $BMDL_{20}$ of 135 mg/kg/d (males) and 143 mg/kg/d (females). This benchmark dose (BMD) is the lower 95% confidence interval for the estimated mean dose at which 20% RBC AChEI is observed. |
| 870.3200 – 21-Day dermal toxicity (NZ rabbit) (96%, a.i.) | MRID 46790501 (2006) Doses: 0, 75, 100, 150, 500 mg/kg/day Acceptable/guideline | $BMDL_{10}$ = 80 mg/kg/d (females) and $BMD_{10}$ = 124 mg/kg/d. This benchmark dose (BMD) is the lower 95% confidence interval for the estimated mean dose at which 10% RBC AChEI is observed. (No model fit for male data at $BMD_{10}$ level.) $BMDL_{20}$=92.2/119.6 mg/kg/day (M/F) $BMD_{20}$=123.9/145.2 mg/kg/day (M/F)) Dermal irritation noted at all doses. |
| 870.3465 - 90-day Inhalation- Rat (96.4% a.i.) | MRID 43266601 (1994) Whole-body inhalation exposures of: 0, 0.1, 0.45, 2.01 mg/L Acceptable/guideline | Portal-of Entry NOAEL= not established; LOAEL= 0.1 mg/L (LDT), based on histopathological lesions of the nasal cavity and larynx in males and females.<br><br>Systemic, RBC AChEI, $BMDL_{10}$= 0.082/0.049 mg/L (M/F); $BMD_{10}$= 0.167/.0126 mg/L (M/F). |
| 870.3465 - 2-week (range-finding) Inhalation-Rat (96.4%, a.i.) | MRID 44554301 (1993) Dose level: 0, 0.5, 1.5, 4.5 mg/L Acceptable/nonguideline | Portal-of-Entry NOAEL= not established; LOAEL= 0.5 mg/L, based on nasal and laryngeal epithelial effects<br><br>Systemic, AChEI NOAEL= not established; LOAEL= 0.5 mg/L based on RBC AChEI. |
| 870.3700a - Developmental-Rat (94%, a.i.) | MRID 41160901 (1989) Doses: 0, 200, 400, 800 mg/kg/d (Days 6-15 of gestation) Acceptable/guideline | Maternal NOAEL= 400 mg/kg/day Maternal LOAEL= 800 mg/kg/day, based on reduced mean body weight gains and reduced mean food consumption.<br><br>Developmental NOAEL= 800 mg/kg/day Developmental LOAEL >800 mg/kg/day; no adverse developmental effects were observed at the highest dose tested. |

| Subchronic, Chronic and Other Toxicity Profile for Malathion | | |
|---|---|---|
| **Guideline Number/ Study Type** | **MRID(s)/ Year Doses/Classification** | **Results** |
| 870.3700b - Developmental-Rabbit (92.4%, a.i.) | MRID 00152569 (1985) and Supplemental Report MRID 40812001 (1985)<br>Doses: 0, 25, 50, 100 mg/kg/d (Days 6-18 of gestation)<br>Acceptable/guideline | Maternal NOAEL= 25 mg/kg/day<br>Maternal LOAEL= 50 mg/kg/day, based on reduced mean body weight gains during period of malathion exposure (Days 6-18 of gestation).<br><br>Developmental NOAEL= 25 mg/kg/day<br>Developmental LOAEL= 50 mg/kg/day; increased mean number of resorption sites/dose.<br><br>(NOTE: Cholinergic signs and mortality seen in range-finding study at 200 and 400 mg/kg/day). |
| 870.3800 - Two-generation Reproduction-Rat (94%, a.i.) | MRID 41583401 (1997)<br>Doses: 0, 550, 1700, 5000, 7500 ppm in feed (equivalent to 0, 43, 131, 394, and 612 mg/kg/d in males and 0, 51, 153, 451, and 703 mg/kg/d in females)<br>Acceptable/guideline | Parental NOAEL=394/451 mg/kg/day; LOAEL= 612 /703 mg/kg/day (M/F) based on decreased F0 generation body weights during gestation and lactation (females) and decreased F1 pre-mating body weights (males and females).<br><br>Offspring NOAEL= 131 /153 mg/kg/day (M/F)<br>Offspring LOAEL= 394 /451 mg/kg/day (M/F), based on decreased pup body weights during the late lactation period in F1 and F2 pups. |
| 870.4100 - Chronic toxicity-dogs (95%, a.i.) | MRID 40188501 (1987)<br>Dose level:0,62.5,125,250 mg/kg/day (gelatin capsule)<br>Acceptable/non-guideline | Systemic NOAEL: >250 mg/kg/day (HDT)<br>AChEI NOAEL= Not established.<br>AChEI LOAEL <62.5 mg/kg/day based on plasma and RBC AChEI. |
| 870.4200 - Combined chronic toxicity/ carcinogenicity-F344 rats (97.1%, a.i.) | MRID 43942901 (1996)<br>Dose levels: 0, 50/100, 500, 6000, 12000 ppm (4/5, 29/35, 359/415, 739/868 mg/kg/d (M/F)<br>Acceptable/guideline | AChEI NOAEL= 3 mg/kg/day (see note below)<br>AChEI LOAEL= 35 mg/kg/day, based on significant RBC AChEI in females.<br><br>Increased incidence of liver tumors in female rats only at excessive doses.<br><br>NOTE: The low dose level was 100 ppm in the diet for three months which was dropped to 50 ppm for the remainder of the study (21 more months). The calculated dose for the three-month exposure was 7 (M) and 8 (F). The calculated dose from the 21 month exposure was 2 (M) and 3 (F) mg/kg/d. Assuming that a LOAEL for AChEI could be 8 mg/kg/d for three months [based on effects observed in females at that time), then a reasonable NOAEL would be 3 mg/kg/day for the 24 month study (the 21-month exposure value for females). |
| 870.4200 - Combined chronic toxicity/ carcinogenicity-F344 rats (96.4%, a.i.) | MRID 43975201 (1996)<br>Dose levels: 0, 20, 1000, 2000 ppm in feed (equivalent to 0, 1, 57, 114 mg/kg/d in males and 0, 1, 68, 141 mg/kg/d in females).<br>Acceptable/guideline | AChEI NOAEL= not determined<br>AChEI LOAEL= 1 mg/kg/day based on 19-21% RBC AChEI males at 6 months.<br><br>Systemic NOAEL= 1 mg/kg/d<br>Systemic LOAEL= 57 mg/kg/d (males - mineral deposits in stomach muscularis) and 68 mg/kg/d (females - mortality, histological changes in nasoturbinates, lung interstitium, and tympanic cavity.<br><br>Increased incidence of leukemia in male rats at highest dose only. |
| 870.4300 - | MRID 43407201 (1994) | Systemic NOAEL= 143/167 mg/kg/day (M/F) |

| Subchronic, Chronic and Other Toxicity Profile for Malathion | | |
|---|---|---|
| **Guideline Number/ Study Type** | **MRID(s)/ Year Doses/Classification** | **Results** |
| Carcinogenicity-B6C3F1 mice (96.4%, a.i.) | Dose levels: 0, 100, 800, 8000, 16000 ppm<br>0, 17.4/20.8,143/167, 1476/1707, 2978/3448 mg/kg/d, M/F).<br>Acceptable/guideline | Systemic LOAEL: 1476/1707 mg/kg/day (M/F), based on decreased body weights and food consumption, increased liver weight, and increased hepatocellular hypertrophy in males and females.<br><br>AChEI NOAEL= 17.4/20.8 mg/kg/day (M/F)<br>AChEI LOAEL= 143/167 mg/kg/day (M/F), based on plasma and RBC AChEI in males and females.<br><br>Increased incidence of liver tumors in male and female mice only at excessive doses. |
| 870.5100 - Bacterial Reverse Gene Mutation Assay (95.2%, a.i.) | MRID 40939302 (1987)<br>Acceptable/guideline | Negative in *Salmonella typhimurium* and in *Escherichia coli* up to the limit dose (5,000 µg/plate +/- S9) in independent tests. |
| 870.5300 – Mouse Lymphoma Forward Gene Mutation | MRID 45554501 (2001)<br>Doses: up to ≥ 1000 ug/mL<br>Acceptable/guideline | In a cell forward gene mutation assay at the TK $^{+/-}$ locus, independent tests were negative up to cytotoxic doses without S9 activation (≥1000 µg/mL) and weakly positive with S9 activation over a narrow range of cytotoxic concentrations (2000 and 2200 µg/mL). |
| 870.5385 - Mammalian Bone Marrow Chromosome Aberration Test In vivo (rats) (94%, a.i.) | MRID 41451201 (1990)<br>Doses: 500 to 2000 mg/kg (single oral dose)<br>Acceptable/guideline | Negative. A dose-related reduction in mitotic indices (MI) was seen in treated females at 24 hours. Reduced MIs were also seen in high-dose males and females at 48 hours. |
| 870.5550 - Unscheduled DNA Synthesis in Mammalian Cells (rat) in Culture (94%, a.i..) | MRID 41389301 (1990)<br>Acceptable/guideline | Negative up to cytotoxic concentrations (≥0.12 µL/mL; 150 µg/mL) |
| Alkaline Single Cell Gel Electrophoresis (Comet Assay)<br>Human Lymphocytes<br>Malathion, malaoxon, and isomalathion (99.8%, a.i.) | MRID 45686902 (1999)<br>Acceptable/nonguideline | In a comet assay, malathion was negative in peripheral blood lymphocytes exposed to 25, 75, or 200 µM (the highest concentration tested). By contrast, 200 µM malaoxon or 200 µM isomalathion induced dose-related significant increases in DNA damage). |
| 870.6100 - Acute Oral Delayed Neurotoxicity in the Hen (93.6%, a.i.) | MRID 40939301 (1988)<br>Doses: 0, 10007.5 mg/kg followed by 852.5 mg/kg/d 21 days later (all hens pre-treated with atropine before each dose)<br>Acceptable/guideline | Neither gross necropsies nor histopathological examination revealed any treatment-related effects in treated hens. Negative for any evidence of acute delayed neurotoxicity. |
| 870.6200a Acute neurotoxicity-Rat (96.4%, a.i.) | MRID 43146701 (1994)<br>Doses: 0, 500, 1000, 2000 mg/kg/d)<br>Acceptable/guideline | NOAEL = 1000 mg/kg<br>LOAEL = 2000 mg/kg (limit dose), based on decreased motor activity and clinical signs at the peak time of effect on day 1 (15 min post dosing) and plasma and RBC AChEI at day 7. |
| 870.6200b Subchronic neurotoxicity- Rat (96.4%, a.i.) | MRID 43269501 (1994)<br>Doses: 0, 50, 5000, 20,000 ppm in diet (equivalent to 0, 4, 352, 1486 mg/kg/d in males and 0, 4, 395, 1575 mg/kg/d in females).<br>Acceptable/guideline | NOAEL= 4 mg/kg/day (M/F)<br><br>LOAEL= 352/395 mg/kg/day (M/F), based on plasma, RBC AChEI in males and females and brain AChEI in females. |

| Subchronic, Chronic and Other Toxicity Profile for Malathion | | |
|---|---|---|
| **Guideline Number/ Study Type** | **MRID(s)/ Year Doses/Classification** | **Results** |
| 870.6300<br>Developmental neurotoxicity – rat (96%, a.i.) | MRID 45646401 (2002)<br>Doses: 0, 5, 50, 150 mg/kg/d<br>Acceptable/guideline | Maternal NOAEL= 50 mg/kg/day<br>Maternal LOAEL= 150 mg/kg/day, based on increased incidence of post-dosing salivation<br><br>Offspring NOAEL= 50 mg/kg/day)<br>Offspring LOAEL= 150 mg/kg/day, based on clinical signs (whole body tremors, hypoactivity, prostrate posture, partially closed eyelids) and brain morphometrics (increased thickness of the corpus callosum in PND 63-67 males and females.) |
| 870.6300<br>Comparative ChE study – rat (96.0%??? a.i.) | MRID 45566201 (2001)<br>Acute exposures (adults and pups, PND 11) - 0, 5, 50, 150, 450 mg/kg/d.<br>Repeat exposures (11 days to both adults and pups PND 11-21): 0, 5, 50, 150 mg/kg/d.<br>Acceptable/nonguideline | Acute exposures<br>$BMDL_{10}$ = 13.6/14.1 mg/kg (offspring, M/F). This benchmark dose (BMD) is the lower 95% confidence interval for the estimated mean dose at which 10% RBC AChEI is observed. $BMD_{10}$= 16.9/18.3 mg/kg (offspring, M/F). No model had good fit for adult male and female data.<br><br>Repeated exposures (11 days)<br>$BMDL_{10}$ = 11.2/12.2 mg/kg/d (offspring, M/F) and 24.7/21.0 mg/kg (adult, males/females). This benchmark dose (BMD) is the lower 95% confidence interval for the estimated mean dose at which 10% RBC AChEI is observed. $BMD_{10}$= 14.3/14.4 mg/kg/d (offspring, M/F) and 27.9/24.0 mg/kg/d (adult, M/F) |
| 870.6300<br>Comparative ChE study – rat<br>(malathion, 96%; and malaoxon 97.7%) | MRID 46822201 (2006)<br>Repeat exposures (pups at PND 11-21):<br>Malathion: 0, 5, 25, 50, 150 mg/kg/d.<br>Malaoxon: 0.1, 1, 2.5, 4 mg/kg/day<br>Acceptable/nonguideline | Repeated exposures (PND 11-21)<br>Malathion:<br>$BMDL_{10}$ = 9.1/9.7 mg/kg/d (M/F). This benchmark dose (BMD) is the lower 95% confidence interval for the estimated mean dose at which 10% RBC AChEI is observed.<br>$BMD_{10}$=13.3/13.1 mg/kg/day (M/F)<br>Malaoxon:<br>$BMDL_{10}$ = 0.53/0.51 mg/kg/d (males/females). This benchmark dose (BMD) is the lower 95% confidence interval for the estimated mean dose at which 10% RBC AChEI is observed.<br>$BMD_{10}$= 0.84/0.61 mg/kg/day (M/F) |
| 870.6300<br>Comparative ChE study – rat<br>(malathion, 96%; and malaoxon 97.7%) | MRID 47373704 (2008)<br>Acute dose (PND 11)<br>Malathion: 0,10,25,50,100,150 mg/kg<br>Malaoxon: 0,1.0,3.5,7.0,10.0,12.5 mg/kg<br>Acceptable/nonguideline | Acute exposure (PND 11)<br>Malathion:<br>$BMDL_{10}$ = 11.5/10.3 mg/kg (M/F). This benchmark dose (BMD) is the lower 95% confidence interval for the estimated mean dose at which 10% RBC AChEI is observed.<br>$BMD_{10}$=13.8/12.9 mg/kg/day (M/F)<br>Malaoxon:<br>$BMDL_{10}$ = 0.43 mg/kg (females). This benchmark dose (BMD) is the lower 95% confidence interval for the estimated mean dose at which 10% RBC AChEI is observed. $BMD_{10}$= 0.60 mg/kg/day (females). No model had good fit for male data. |
| 870.7800<br>Immunotoxicity (96.0%, a.i.) | MRID 48550501 (2011)<br>Doses: 0, 8.9, 17.6, 126.8, 1215.8 mg/kg/day<br>Acceptable/guideline | The systemic toxicity NOAEL is 100 ppm (equivalent to 17.6mg/kg bw/day); the LOAEL was 700 ppm (equivalent to 126.8 mg/kg bw/day) based on statistically significant reductions in RBC cholinesterase activity.<br>The NOAEL for immunotoxicity is 7000 ppm (highest dose tested; equivalent to 1215.8 mg/kg/day); the LOAEL was not established (>7000 ppm). |
| 870.7485<br>Metabolism | MRID 41367701 (1989)<br>Acceptable/guideline | Malathion and its metabolites are excreted primarily in the urine (80-90%) in the first 24 hours following exposure, with lesser amounts excreted in the feces. At 72 hours, the highest concentration of radioactivity was observed in the liver, but less than 0.3% of the administered radioactivity was present in that organ. Radioactivity did not bioaccumulate in any of the |

| Subchronic, Chronic and Other Toxicity Profile for Malathion | | |
|---|---|---|
| **Guideline Number/ Study Type** | **MRID(s)/ Year Doses/Classification** | **Results** |
| | | organ/tissues analyzed. Although eight radiolabeled metabolites were observed in urine, greater than 80% of the radioactivity in urine was represented by the diacid (DCA) and monoacid (MCA) metabolites. The remaining radiolabeled metabolites were identified as components of "peak A" and "peak B." It was estimated that between 4 and 6% of the administered dose was converted to malaoxon, the active AChE inhibiting metabolite of malathion. |

**D3.** Summary of OPP's Cholinesterase Policy & Use of BMD Modeling

OPP's ChE policy (USEPA, 2000[15]) describes the manner in which ChE data are used in human health risk assessment. The following text provides a brief summary of that document to provide context to points of departure selected.

AChE inhibition can be inhibited in the central or peripheral nervous tissue. Measurements of AChE or cholinesterase (ChE) inhibition in peripheral tissues (e.g., liver, diaphragm, heart, lung etc) are rare. As such, experimental laboratory studies generally measure brain (central) and blood (plasma and red blood cell, RBC) ChE. Blood measures do not represent the target tissue, per se, but are instead used as surrogate measures for peripheral toxicity in studies with laboratory animals or for peripheral and/or central toxicity in humans. In addition, RBC measures represent AChE, whereas plasma measures are predominately butyryl-ChE (BuChE). Thus, RBC AChE data may provide a better representation of the inhibition in target tissues. As part of the dose response assessment, evaluations of neurobehavior and clinical signs are performed to consider the dose response linkage between AChE inhibition and apical outcomes.

Refinements to OPP's use of ChE data have come in the implementation of BMD approaches in dose response assessment. Beginning with the OP CRA, OPP has increased its use of BMD modeling to derive PoDs for AChE inhibiting compounds. Most often the decreasing exponential empirical model has been used.

OPP does have not a defined benchmark response (BMR) for OPs. However, the 10% level has been used in the majority of dose response analyses conducted to date. This 10% level represents a 10% reduction in AChE activity (i.e., inhibition) compared to background (i.e., controls). Specifically, the $BMD_{10}$ is the estimated dose where ChE is inhibited by 10% compared to background. The $BMDL_{10}$ is the lower confidence bound on the $BMD_{10}$.

[15] USEPA (2000) Office of Pesticide Programs, US Environmental Protection Agency, Washington DC 20460. August 18, 2000 Office of Pesticide Programs Science Policy of The Use of Data on Cholinesterase Inhibition for Risk Assessments of Organophosphorous and Carbamate Pesticides.

The use of the 10% BMR is derived from a combination of statistical and biological considerations. A power analysis was conducted by the Office of Research and Development (ORD) on over 100 brain AChE datasets across more than 25 OPs as part of the OP CRA (USEPA, 2002). This analysis demonstrated that 10% is a level that can be reliably measured in the majority of rat toxicity studies. In addition, the 10% level is generally at or near the limit of sensitivity for discerning a statistically significant decrease in ChE activity in the brain compartment and is a response level close to the background brain ChE level. With respect to biological considerations, a change in 10% brain AChE inhibition is protective for downstream clinical signs and apical neurotoxic outcomes. With respect to RBC AChE inhibition, these data tend to be more variable than brain AChE data. OPP begins its BMD analyses using the 10% BMR for RBC AChE inhibition but BMRs up to 20% could be considered on a case by case basis as long as such PoDs are protective for brain AChE inhibition, potential peripheral inhibition, and clinical signs of neurotoxicity.

**Summary Tables of Benchmark Dose (BMD) Analyses in Rat Toxicity Studies**

BMD analyses were performed with EPA's Benchmark Dose Software (Version 2.4) using an exponential model for continuous data. The Hill model was also performed for some data sets, when acceptable fits were not obtained with the exponential model. All malathion and malaoxon data from these studies were considered; however, some data were not amenable to BMD analysis. Results and technical details for these analyses can be found in the latest BMD memo (R. Bever, 7/1/2014, TXR 0056947).

**Table D.1. Results of BMD Modeling (mg/kg) for RBC ChE Data on Malathion, Acute Oral Dosing Studies in Rats.**

| Study | Age Sex | $BMD_{10}$ | $BMDL_{10}$ |
|---|---|---|---|
| MRID 45566201 Acute CCA | Adult Male | NF | |
| MRID 45566201 Acute CCA | Adult Female | NF | |
| MRID 45566201 Acute CCA | PND 11 Male | 16.911 | 13.571 |
| MRID 45566201 Acute CCA | PND 11 Female | 18.324 | 14.028 |
| MRID 47373704 Acute CCA | PND 11 Male | 13.860 | 11.476 |
| MRID 47373704 Acute CCA | PND 11 Female | 12.435 | 10.305 |

CCA = Comparative Cholinesterase Assay
NF indicates that no model obtained good fit.

**Table D.2. Results of BMD Modeling (mg/kg/day) for RBC ChE Data on Malathion, Repeated Oral Dosing Studies in Rats.**

| Study (dosing days) | Age Sex | $BMD_{10}$ | $BMDL_{10}$ |
|---|---|---|---|
| MRID 45566201 Repeated Dose CCA (10) | Adult Male | 27.946 | 24.691 |
| MRID 45566201 Repeated Dose CCA (10) | Adult Female | 24.002 | 21.040 |
| MRID 45566201 Repeated Dose CCA (10) | PND 11 Male | 14.269 | 11.176 |
| MRID 45566201 Repeated Dose CCA (10) | PND 11 Female | 14.419 | 12.235 |
| MRID 45566201 Gestational CCA (15) | Dam | 21.826 | 17.056 |
| MRID 45566201 Gestational CCA | Fetus M & F | NDR | |

CCA = comparative cholinesterase assay
NDR = No dose response

**Table D.3. Results of BMD Modeling (mg/kg/day) for RBC ChE Data on Malathion, Dermal Toxicity in Rats.**

| Study (dosing days) | Age Sex | $BMD_{10}$ | $BMDL_{10}$ |
|---|---|---|---|
| MRID 46821601 21-Day Dermal Tox (Day 21) | Adult Male | NA | |
| MRID 46821601 28-Day Dermal Tox (Day 21) | Adult Female | 123.985 | 79.776 |

NF indicates that no model obtained good fit.
NA indicates that while this model fit the data statistically, the team considered the results to be inaccurate.

**Table D.4. Results of BMD Modeling (mg/L/day) for RBC ChE Data on Malathion, Inhalation Toxicity in Rats.**

| Study (dosing days) | Age Sex | $BMD_{10}$ | $BMDL_{10}$ |
|---|---|---|---|
| MRID 43266601 90-day Inhalation Tox (Day 90) | Adult Male | 0.167 | 0.082 |
| MRID 43266601 | Adult Female | 0.126 | 0.050 |

90-day Inhalation
Tox (Day 90)

**Table D.5. Results of BMD Modeling (mg/kg/day) for RBC ChE Data on Malaoxon, Acute and Repeated Dose Oral Toxicity in Rats.**

| Study (dosing days) | Age Sex | $BMD_{10}$ | $BMDL_{10}$ |
|---|---|---|---|
| MRID 47373704 Acute CCA (1) | PND 11 Male | NF | |
| MRID 47373704 Acute CCA (1) | PND 11 Female | 0.604 | 0.433 |
| MRID 46822201 Repeated Dose CCA (10) | PND 11 Male | 0.839 | 0.530 |
| MRID 46822201 Repeated Dose CCA (10) | PND 11 Female | 0.608 | 0.511 |

CCA = comparative cholinesterase assay
NF indicates that no model obtained good fit.

## Appendix E. Summary of Malathion Specific Dislodgeable Foliar Residue and Turf Transferable Residue Data

Dislodgeable Foliar Residue Studies

(Please refer to: J. Arthur. D330675, 7/6/2006)

A total of six studies are described in this section. The studies were all conducted by the ARTF for use in defining generic transfer coefficients. Malathion is one of the compounds selected by the ARTF as a surrogate chemical for its efforts. These studies quantified residue dissipation and exposure during scouting in grapes, harvesting in grapes, apples, squash and blackberries, and pruning nursery stock. The DFR component of those studies has been extracted for chemical-specific use in this risk assessment. It should noted that no discussion of malaoxon was provided in the listed DFR studies. The studies which have been used in this assessment are identified below followed by a brief summary of each:

**MRID 450059-10. ARTF Study No. ARF023. "Determination of Dermal and Inhalation Exposure to Reentry Workers During Scouting in Grapes," November 1999.**

This study was conducted with Malathion 57 EC® for the purpose of establishing transfer coefficients. Only the dislodgeable foliar residue (DFR) portion of the study was used in the post-application assessment, and is summarized here. Two applications of malathion were made at seven days apart, to test plots in the San Joaquin Valley of California, by vertical boom sprayer at a rate of 1 lb ai/A in a spray volume of 210 gal/A. Samples were collected prior to the first application, and on day 0 (after spray was dry). Following the second application, DFR samples were collected on day 0 (after spray was dry), and then at 1, 2, 3, 4, 5, 6, 7, 14 and 21 days after application. On the sampling days, triplicate samples were collected across the two test subplots and single samples from a separate untreated control plot. Forty leaf punches were obtained for each sample with a Birkestrand leaf punch, resulting in 400 $cm^2$ of leaf surface (both sides) per sample. Residues on leaf discs were dislodged with 0.01% Aerosol OT solution. The limit of quantitation (LOQ) in this study was 2.0 ug/sample or 0.005 $ug/cm^2$. Field recovery values were within the acceptable range. No significant rainfall event was evident that might affect results. The study measured malathion residue only. EPA ran new DFR regressions for the post-application risk assessment in order to assess potential risk from the oxon product as well as the parent malathion. The dissipation curve was based on malathion DFRs plus estimated malaoxon residue. The oxon was estimated to be 5% of the parent residue. A toxicity factor of 22 was also applied to malaoxon residue. Results of the statistical analysis of the data are presented in the table below.

| **Grape DFR Dissipation Data (MRID 450059-10) Malathion Plus Estimated Malaoxon Residues** | | | | | |
|---|---|---|---|---|---|
| Location | App. Rate in Study (lb ai/A) | Corr. Coeff. (adjusted $R^2$) | Slope of Semilog Regression | Day 0 Conc. ($ug/cm^2$) | % Dissipation/Day |
| CA | 1.0 | 0.91 | -0.3707 | 0.62 predicted<br>2.91 actual | 24% |

These residue data were extrapolated in the post-application assessment of malathion to cover the following currently labeled crops: blueberry (highbush), currant, grape, hop, and passion fruit.

**MRID 454919-01. ARTF Study No. ARF048. "Determination of Dermal and Inhalation Exposure to Reentry Workers During Harvesting in Wine Grapes," March 2001.**

This study was conducted with Malathion 57 EC® for the purpose of establishing transfer coefficients. Only the dislodgeable foliar residue (DFR) portion of the study was used in the post-application assessment, and is summarized here. Two applications of malathion were made at seven days apart, to test plots in Sanger, California, by vertical boom sprayer at a rate of 0.93 lb ai/A in a spray volume of 218 gal/A. Samples were collected just before the first application and on day 0 (after spray was dry). Following the second application, DFR samples were collected on day 0 (after spray was dry), and then at 1, 2, 3, 4, 5, 6, 7, 10 and 14 days after application. On the sampling days, triplicate samples were collected across the two test subplots and single samples from a separate untreated control plot. Forty leaf punches were obtained for each sample with a Birkestrand leaf punch, resulting in 400 $cm^2$ of leaf surface (both sides) per sample. Residues on leaf discs were dislodged with 0.01% Aerosol OT solution. The limit of

quantitation (LOQ) in this study was 2.0 ug/sample or 0.005 ug/cm$^2$. No significant rainfall event was evident that might affect results. Results of the statistical analysis of the data are presented in the table below.

| Wine Grape DFR Dissipation Data (MRID 454919-01) | | | | | |
|---|---|---|---|---|---|
| Location | App. Rate in Study (lb ai/A) | Corr. Coeff. (adjusted $R^2$) | Slope of Semilog Regression | Day 0 Conc. (ug/cm$^2$) | % Dissipation/Day |
| CA | 0.93 | 0.92 | -0.4367956 | 0.57 | 35 |

These residue data would cover grapes, hops and passion fruit, however, they were not extrapolated in the post-application assessment of malathion. Data from the grape study, MRID 450059-10, were used because they represent a more conservative surrogate screen.

**MRID 451382-02. ARTF Study No. ARF025. "Determination of Dermal and Inhalation Exposure to Reentry Workers During Harvesting in Apples," January 2000.**

This study was conducted with Malathion 57 EC® for the purpose of establishing transfer coefficients. Only the dislodgeable foliar residue (DFR) portion of the study was used in the post-application assessment, and is summarized here. Two applications of malathion were made at ten days apart, to test plots in Orefield, Pennsylvania, by airblast sprayer at a rate of 1.25 lb ai/A in a spray volume of 125 gal/A. Samples were collected two days before the first application and on day 0 (after spray was dry). Following the second application, DFR samples were collected on day 0 (after spray was dry), and then at 1, 2, 3, 5, 6, 7, and 15 days after application. On the sampling days, triplicate samples were collected across the two test subplots and single samples from a separate untreated control plot. Forty leaf punches were obtained for each sample with a Birkestrand leaf punch, resulting in 400 cm$^2$ of leaf surface (both sides) per sample. Residues on leaf discs were dislodged with 0.01% Aerosol OT solution. The limit of quantitation (LOQ) in this study was 2.0 ug/sample or 0.005 ug/cm$^2$. A rainfall event between day 3 and 4 following application significantly lowered DFR values. The study measured malathion residue only. EPA ran new DFR regressions for the post-application risk assessment in order to assess potential risk from the oxon product as well as the malathion. The dissipation curve was based on malathion DFRs plus estimated malaoxon residue. The oxon was estimated to be 5% of the parent residue. A toxicity factor of 22 was also applied to malaoxon residue. Results of the statistical analysis of the data are presented in the table below.

| Apple DFR Dissipation Data (MRID 451382-02) Malathion Plus Estimated Malaoxon Residues | | | | | |
|---|---|---|---|---|---|
| Location | App. Rate in Study (lb ai/A) | Corr. Coeff. (adjusted $R^2$) | Slope of Semilog Regression | Day 0 Conc. (ug/cm$^2$) | % Dissipation/Day |
| PA | 1.25 | 0.80 | -0.5129 | 3.24 predicted<br>5.57 actual | 40 |

These residue data were extrapolated in the post-application assessment of malathion to cover the following currently labeled crops: apricot, avocado, cherry, chestnut, date, fig, grapefruit, guava, kumquat, lemon, lime, macadamia nut, mango, nectarine, orange, papaya, peach, pear, pecan, tangelo, tangerine, walnut, pine seed orchards and Christmas tree plantation.

**MRID 454919-02. ARTF Study No. ARF049. "Determination of Dermal and Inhalation Exposure to Reentry Workers During Harvesting in Summer Squash," May 2001.**

This study was conducted with Malathion 57 EC® for the purpose of establishing transfer coefficients. Only the dislodgeable foliar residue (DFR) portion of the study was used in the post-application assessment, and is summarized here. Two applications of malathion were made at seven days apart, to test plots in Porterville, California, by tractor-mounted boom sprayer at a rate of 0.95 lb ai/A in a spray volume of 20 gal/A. Samples were collected on the day before the first application and on day 0 (after spray was dry). Following the second application, DFR samples were collected on day 0 (after spray was dry), and then at 1, 2, 3, 4, 5, 6, and 7 days after application. On the sampling days, triplicate samples were collected across the two test subplots and single samples from a separate untreated control plot. Forty leaf punches were obtained for each sample with a Birkestrand leaf punch, resulting in 400 $cm^2$ of leaf surface (both sides) per sample. Residues on leaf discs were dislodged with 0.01% Aerosol OT solution. The limit of quantitation (LOQ) in this study was 2.0 ug/sample or 0.005 $ug/cm^2$. No significant rainfall events were evident to affect the results. The study measured malathion residue only. EPA ran new DFR regressions for the post-application risk assessment in order to assess potential risk from the oxon product as well as the malathion. The dissipation curve was based on malathion DFRs plus estimated malaoxon residue. The oxon was estimated to be 5% of the parent residue. A toxicity factor of 22 was also applied to malaoxon residue. Results of the statistical analysis of the data are presented in the table below.

| **Squash DFR Dissipation Data (MRID 454919-02) Malathion Plus Estimated Malaoxon Residues** | | | | | |
|---|---|---|---|---|---|
| Location | App. Rate in Study (lb ai/A) | Corr. Coeff. (adjusted $R^2$) | Slope of Semilog Regression | Day 0 Conc. ($ug/cm^2$) | % Dissipation/Day |
| CA | 0.95 | 0.86 | -0.584 | 11.73 predicted<br>8.31 actual | 44% |

These residue data were extrapolated in the post-application assessment of malathion to cover the following currently labeled crops: alfalfa, asparagus, barley, bean, bermuda grass, beet, broccoli, broccoli-raab, brussels sprout, cabbage, carrot, cantaloupe, cauliflower, celery, chayote root, chayote fruit, chinese broccoli, chinese green, clover, collards, corn, cotton, cucumber, cut flowers, dandelion, eggplant, endive, flax, garlic, grasses (hay, forage), horseradish, kale, kohlrabi, leeks, lespedeza, lettuce, lupine, melon, mint, mushroom, mustard greens, oats, okra, onion, parsley, parsnip, pea, pepper, potato, pumpkin, radish, rice, rutabaga, rye, salsify, shallot, sorghum grain, spinach, squash, sweet potato, Swiss chard, tomato, tomatillo, turnip, vetch, watercress, watermelon, wheat, wild rice and yam.

**MRID 451382-01. ARTF Study No. ARF020. "Determination of Dermal and Inhalation Exposure to Reentry Workers During Hand-Harvesting in Blackberries," January 2000.**

This study was conducted with Malathion 57 EC® for the purpose of establishing transfer coefficients. Only the dislodgeable foliar residue (DFR) portion of the study was used in the post-application assessment, and is summarized here. Two applications of malathion were made at seven days apart, to test plots in Mount Angel, Oregon, by airblast sprayer at a rate of 1.9 lb ai/A in a spray volume of 90 gal/A. Samples were collected on the day before the first application and on day 0 (after spray was dry). Following the second application, DFR samples were collected on day 0 (after spray was dry), and then at 1, 2, 3, 4, 5, 6, 7 and 14 days after application. On the sampling days, triplicate samples were collected across the two test subplots and single samples from a separate untreated control plot. Eighty leaf punches were obtained for each sample with a Birkestrand leaf punch, resulting in 400 $cm^2$ of leaf surface (both sides) per sample. Residues on leaf discs were dislodged with 0.01% Aerosol OT solution. The limit of quantitation (LOQ) in this study was 2.0 ug/sample or 0.005 $ug/cm^2$. No rainfall events were evident to affect the results. The study measured malathion residue only. EPA ran new DFR regressions for the post-application risk assessment in order to assess potential risk from the oxon product as well as the malathion. The dissipation curve was based on malathion DFRs plus estimated malaoxon residue. The oxon was estimated to be 5% of the parent residue. A toxicity factor of 22 was also applied to malaoxon residue. Results of the statistical analysis of the data are presented in the table below.

| Nursery Stock DFR Dissipation Data (MRID 451382-01) Malathion Plus Estimated Malaoxon Residues | | | | | |
|---|---|---|---|---|---|
| Location | App. Rate in Study (lb ai/A) | Corr. Coeff. (adjusted $R^2$) | Slope of Semilog Regression | Day 0 Conc. ($ug/cm^2$) | % Dissipation/Day |
| OR | 1.9 | 0.92 | -0.3972 | 1.44 predicted<br>2.60 actual | 33% |

These residue data were extrapolated in the post-application assessment of malathion to cover the following currently labeled crops: blackberry, blueberry (lowbush), boysenberry, dewberry, gooseberry, loganberry, pineapple, raspberry and strawberry.

**MRID 454695-01. ARTF Study No. ARF043. "Determination of Dermal and Inhalation Exposure to Reentry Workers During Pruning in Nursery Stock," January 2000.**

This study was conducted with Malathion 57 EC® for the purpose of establishing transfer coefficients. Only the dislodgeable foliar residue (DFR) portion of the study was used in the post-application assessment, and is summarized here. A single application of malathion was made to test plots of assorted citrus trees in Yuma, Arizona, by commercial boom sprayer at a rate of 1.3 lb ai/A in a spray volume of 47 gal/A. Samples were collected on the day before application, on day 0 (after spray was dry), and then at 1, 2, 3, 4, 5, 6, 7 and 14 days after application. On the sampling days, triplicate samples were collected across the two test subplots

and single samples from a separate untreated control plot. Forty leaf punches were obtained for each sample with a Birkestrand leaf punch, resulting in 400 $cm^2$ of leaf surface (both sides) per sample. Residues on leaf discs were dislodged with 0.01% Aerosol OT solution. The limit of quantitation (LOQ) in this study was 2.0 ug/sample or 0.005 $ug/cm^2$. No rainfall events were evident to affect the results. The study measured malathion residue only. EPA ran new DFR regressions for the post-application risk assessment in order to assess potential risk from the oxon product as well as the malathion. The dissipation curve was based on malathion DFRs plus estimated malaoxon residue. The oxon was estimated to be 5% of the parent residue. A toxicity factor of 22 was also applied to malaoxon residue. Results of the statistical analysis of the data are presented in the table below.

| **Nursery Stock DFR Dissipation Data (MRID 454695-01) Malathion Plus Estimated Malaoxon Residues** | | | | | |
|---|---|---|---|---|---|
| Location | App. Rate in Study (lb ai/A) | Corr. Coeff. (adjusted $R^2$) | Slope of Semilog Regression | Day 0 Conc. ($ug/cm^2$) | % Dissipation/Day |
| AZ | 1.3 | 0.91 | -0.4274 | 1.69 predicted<br>5.52 actual | 35 |

These residue data were extrapolated in the post-application assessment of malathion to cover all currently labeled ornamental crops including nursery stock and shrubs.

Turf Transferable Residue Studies

(Please refer to: J. Arthur, D240569, 1/10/2000)

**MRID 439450-01.** ***A Transferrable Residue Study - Malathion Residues in Turf***

A transferable residue study on turf was conducted with the pesticide malathion formulated as the end use product Malathion 57EC. This study examined the residue levels of malathion that could be transferred from treated turf. Four geographic sites were included in this study to represent the different use areas in the United States. These sites represented cool season grass in the Northeast/mid Atlantic, cool season grass in the Midwest, warm season grass in the South Atlantic/Gulf region, and warm season grass in the Pacific Coastal region.

At each site, one application of Malathion 57EC with a target rate of 5 lb ai per acre (4 quarts of formulated product in 100 gallons of water) was performed with hand-gun spray equipment. These conditions were meant to provide the maximum level of malathion residues. Sprinkler irrigations were performed within one hour of each application, providing approximately 0.1 inch of water.

Field data were collected from June to September, 1995. A total of twelve transferable residue samples and three control samples were collected from each site (three samples collected from a subplot in each of the four treated plots and a control plot at each site). At most locations, samples were collected before and after application, then at 4, 8, 12, 24, 48, and 72 hours after treatment. Transferable residues of malathion were quantified by placing cloth dosimeters on the

turf. A 15-kg roller was then rolled over each dosimeter. Shaken to remove foliage, dosimeters were stored and shipped frozen to the laboratory for analysis.

Three transferable residue samples (replicates) were collected from a randomly chosen subplot in each of the 4 treated plots and the control plot at each of the following intervals: pre-application, post-application prior to irrigation, then at 4, 8 (except Pennsylvania, North Carolina, and Missouri), 12 (except North Carolina), 24, 48, and 72 hours (except North Carolina; some of them were not collected due to rain) after treatment. The 8 hour post-application samples were not collected at the Pennsylvania site since the requirement was added after the sampling was conducted. The 8, 12 hour, and some of the 72 hour samples were not collected at the North Carolina site due to rain.

EPA ran new DFR regressions for the post-application risk assessment in order to assess potential risk from the oxon product as well as the malathion. The dissipation curve was based on malathion TTRs plus estimated malaoxon residue. The oxon was estimated to be 5% of the parent residue. A toxicity factor of 22 was also applied to malaoxon residue. Results of the statistical analysis of the data are presented in the table below.

| **Summary of Malathion + Adjusted Malaoxon TTR Residues and Regression Analysis Results for Turf (MRID 439450-01)** | |
|---|---|
| Pennsylvania | |
| Application Rate (lb ai/A) | 5.26 |
| Average Day 0 Residue (µg/cm$^2$) | 2.56 |
| Predicted Day 0 Residue (µg/cm$^2$) | 1.4 |
| Slope | -1.416 |
| Half-Life (days) | 0.5 |
| $R^2$ | 0.86 |
| North Carolina | |
| Application Rate (lb ai/A) | 4.99 |
| Average Day 0 Residue (µg/cm$^2$) | 0.6225 |
| Predicted Day 0 Residue (µg/cm$^2$) | 0.126 |
| Slope | -1.853 |
| Half-Life (days) | 0.4 |
| $R^2$ | 0.67 |
| Missouri | |
| Application Rate (lb ai/A) | 5.38 |
| Average Day 0 Residue (µg/cm$^2$) | 1.27 |
| Predicted Day 0 Residue (µg/cm$^2$) | 0.517 |
| Slope | -4.065 |
| Half-Life (days) | 0.2 |
| $R^2$ | 0.82 |
| California | |
| Application Rate (lb ai/A) | 5.15 |
| Average Day 0 Residue (µg/cm$^2$) | 1.7 |
| Predicted Day 0 Residue (µg/cm$^2$) | 0.885 |
| Slope | -1.153 |
| Half-Life (days) | 0.6 |
| $R^2$ | 0.87 |

## Appendix F: Inputs for Malathion Mosquitocide Applications - 2012 Residential SOP

### Algorithms; Use of Well Mixed Box Model; *AgDISP* (V8.2.6) Inputs

#### *Mosquitocide Application Post-application Dermal, Incidental Oral, and Inhalation Exposure Algorithms*

##### Aerial Application

Deposition and air concentrations from aerial ULV applications was modeled using the AgDISP (v8.2.6) model which is currently recommended for assessment of mosquito adulticide applications. AgDISP predicts the motion of spray material released from aircraft, and determines the amount of application volume that remained aloft and the amount of the resulting droplets deposited on the surfaces in the treatment area, as well as downwind from the treatment area. The model also allows for the estimation of air concentrations in the breathing zones of adults and children for use in calculating the post-application inhalation risks to individuals residing in areas being treated by aerial application of malathion. The input parameters used as the basis for AgDISP (v8.2.6) calculations are presented below.

**Table D.2 AGDISP Inputs (v8.26): Malathion Mosquitocide ULV Application**

| | |
|---|---|
| Application Method | Aerial |
| Aircraft | Air Tractor AT-401 |
| Release Height | 100 Feet minimum release (EPA Reg No. 67760-34) |
| Spray Lines | 20 Reps |
| Application Technique | Liquid |
| Application Technique *Nozzles* | 3; Extent 76.3%; Spacing 18.7 ft |
| Application Technique *Drop Size Distribution* | User defined<br>Parametric; $D_{V0.5}$: 60.2 µm; and relative span: 1.2.<br>no conversion to Malvern<br>Drop Size Distribution |
| Swath Width | 500 feet |
| Swath Displacement | 0 feet |
| Meteorology | Wind type: single height<br>Wind speed: 1 mph<br>Wind direction: -90 deg<br>Temperature: 85 F°<br>Relative humidity: 50% |
| Spray Material | Name: oil; spray volume rate: 0.023 gal/A (EPA Reg No. 67760-34; Active Fraction: 0.965; Nonvol nonvolatile: 1. (no carrier tank mix) |
| Atmospheric Stability | Overcast |
| Surface | Upslope angle: 0 deg<br>Sideslope angle: 0 deg<br>Canopy: None |
| Transport | Distance: 0 feet |
| Advanced | Default Swatch offset: 0 Swath<br>Specific Gravity carrier and active and additive= 1.0<br>Evaporation Rate: 84.76 |

A sensitivity analysis was completed for the AGDISP (v8.26) inputs corresponding to the release height and wind speed during an application. This analysis is provided below in Table D.3.

**Table D.3. Sensitivity Analysis for the Mosquitocide ULV Application Parameters (i.e., Wind Speed and Release Height)[1]**

| | Fraction of Application Rate for Deposition[2] (unitless) | | Air concentration at breathing height ($mg/m^3$) | |
|---|---|---|---|---|
| ***AGDISP* Parameters** | **100 feet release height** | **300 feet release height** | **100 feet release height** | **300 feet release height** |
| **1 mph** | > 1 (1.65) | 0.41 | 0.075 | 0.012 |
| **3 mph** | > 1 (1.1) | 0.36 | 0.045 | 0.015 |
| **5 mph** | 1.0 | 0.35 | 0.040 | 0.015 |

1. The ULV mosquitocide labels require applications to occur when the wind speed is greater than or equal to 1 mph and not to apply by fixed wing aircraft at height less than 100 feet or by helicopter at a height than 75 feet unless specifically approved by the state or tribe based on public health needs.
2. Where the fraction of application rate for deposition was determined to be greater than 1, the maximum fraction of 1 will be used for the exposure calculations.

### Ground-based Foggers

In the study conducted by Moore *et al.,* [*Downwind Drift and Deposition of Malathion on Human Targets From Ground Ultra-Low Volume Mosquito Sprays*: J.C. Moore, J.C. Dukes, J.R. Clark, J. Malone, C.F. Hallmon, and P.G. Hester; Journal of the American Mosquito Control Association; Vol. 9, No. 2 (June, 1993)] both human exposure and deposition was quantified over 5 separate application events. A 91 percent formulation of malathion was applied in April and May of 1989 in the early evening (a time of day for relative atmospheric stability). A Leco HD ULV cold aerosol generator (Lowndes Engineering Company, Valdosta Georgia) was used to make each application. The application parameters included a fluid flow rate of 4.3 fluid ounces per minute, a vehicle ground speed of 10 mph, and a nominal application rate of 0.05 lb ai/acre (i.e., equates to a deposition rate of 0.51 $\mu g/cm^2$). Deposition was monitored at three locations downwind from the treatment area (i.e., 15.2 m, 30.4 m, and 91.2 m). For the events considered in the deposition calculations, "average amounts of malathion deposited on ground level at 15.2, 30.4, and 91.2 m were not significantly different." The percentage of the application rate reported to have deposited ranged from 1 to 14 percent. The mean deposition value for all measurements was 4.3 percent (n=35, CV=98).

In the study conducted by Tietze *et al.,* [*Mass Recovery of Malathion in Simulated Open Field Mosquito Adulticide Tests*: N.S. Tietze, P.G. Hester, and K.R. Shaffer; Archives of Environmental Contamination and Toxicology; 26: 473-477 (1994)] only deposition was quantified over 6 separate application events (i.e., one event was not included in deposition calculations "due to negative air stability"). The application parameters were similar to that used by Moore *et al*. A 95 percent formulation of malathion was applied from May to August of 1993. A Leco 1600 ULV cold aerosol generator (Lowndes Engineering Company, Valdosta Georgia) was also used to make each application. The application parameters included a fluid flow rate of 4.3 fluid ounces per minute, a vehicle ground speed of 10 mph, and a nominal

application rate of 0.057 lb ai/acre (i.e., equates to a deposition rate of 0.58 µg/cm$^2$). Deposition was monitored at four locations downwind from the treatment area (i.e., 5 m, 25 m, 100 m and 500 m). For the events considered in the deposition calculations, "malathion mass deposited differed significantly between the 500 m site and the three closer sites (df = 3; F-value = 3.42; P<0.05)." The percentage of the application rate reported to have deposited (not including 500 m samples which were much less) ranged up to 5.8 percent. The mean deposition value for all measurements was 3.8 percent.

Additionally, in an analysis from 2013 (C. Peck, D407817, 3/28/2013), the Environmental Fate and Effects Division (EFED) reviewed eight published studies on ground ULV application in which deposition was measured. The studies varied in collection media (i.e., grass clippings and coupons), distance from application or spray head (ranging from 8 meters to 500 meters), and chemical measured (i.e., fenthion, malathion, naled, and permethrin). The analysis included the Moore *et al.,* and Tietze *et al*., studies discussed above. After considering the available data, HED has determined that an off-target deposition rate of 8.7 percent of the application rate may be used by HED to evaluate ground-based ULV applications (i.e., 8.7 percent of the target application rate deposits on turf). This value is the 90 percent upper confidence limit on the mean and is slightly higher than the mean values from all the data points observed in the studies (7.1%, n= 94). The adjusted application rate was then used to define TTR levels by scaling the available TTR data as appropriate.

In order to calculate airborne concentrations from ULV truck fogger applications, HED used the 2012 Residential SOPs for Outdoor Fogging/Misting Systems, with minimal modification to the WMB model. The WMB model allows for the estimation of air concentrations in the breathing zones of adults and children for use in calculating the post-application inhalation exposure to individuals residing in areas being treated by ground application of malathion. The methodology more accurately accounts for dilution using the WMB model. The WMB model input parameters and the algorithms used to estimate residential post-application exposures can be found below.

Post-application Inhalation Exposure Algorithm for Truck Mounted ULV – Well Mixed Box Model

The following algorithm is used to determine post-application inhalation exposure to truck mounted fogger sprays:

$$\text{TWA}\,(\text{mg/m}^3) = \frac{\left[\frac{AR}{Q}\left(1 - e^{-\frac{Q}{V}(ET)}\right)\right]}{AT}$$

where:

[TWA] = time weighted average air concentration (mg/m$^3$);

AR = application rate (mg ai/day);
Q = airflow through the treated area ($m^3$/hour);
V = volume of the box ($m^3$)
ET = time (duration) of exposure (hours); and
AT = averaging time to match the duration of the HEC (hours).

Application rate for WMB analysis can be calculated as follows:

$$AR^* = AR * CF1^* CF2 * CF3$$

where:

AR* = application rate (mg ai/day)
AR = application rate (lb ai/A)
CF1 = unit conversion factor (454 g/lb)
CF2 = unit conversion factor (400$ft^2$/43560 ft2 per acre)
CF3 = unit conversion factor (1000mg/g)

The airflow through the treated space can be calculated as follows:

$$Q = AV * CF1^* CF2 * A_{cross\text{-}section}$$

where:

Q = airflow through treated space ($m^3$/hr);
AV = air velocity (m/s);
CF1 = time unit conversion factor (60 seconds/1 minute);
CF2 = time unit conversion factor (60 minutes / hour); and
$A_{cross\text{-}section}$ = cross-section of outdoor space treated ($m^2$).

**Table D.8: Truck Mounted Mosquito Vector Control Fogger –Inputs for Residential Post-application Inhalation Exposure**

| Algorithm Notation | Exposure Factor (units) | Point Estimate(s) |
|---|---|---|
| AR | Application rate (lb ai/A) | 0.11 (458 mg ai/day) |
| $A_{cross\text{-}section}$ | Cross sectional area of area treated ($m^2$) | 15 |
| AV | Air velocity (m/s) | 0.1 |
| Q | Airflow through treated area ($m^3$/hr) | 5,400 |
| A.I. | Percent ai in product (%) | 96.5% |
| V | Volume of the treated space ($m^3$) | 90 |
| ET | Exposure duration (hours) [equivalent to time spend outdoors on Turf] | 1.5 |
| AT | Averaging Time (hours) | 6 |

| Table D.8: Truck Mounted Mosquito Vector Control Fogger –Inputs for Residential Post-application Inhalation Exposure | | |
|---|---|---|
| **Algorithm Notation** | **Exposure Factor (units)** | **Point Estimate(s)** |
| | [equivalent to duration of inhalation toxicity study] | |

## Appendix G: Non-Occupational (Bystander) Exposure and Risk Estimates for the Spray Drift Assessment

**Table E.1. Adult Risk Estimates (MOEs) Related to Indirect Exposure to Spray Drift for Malathion for the Dermal Route of Exposure**

| Crop/Rate Group | Spray Type/ Nozzle Configuration | Appl. Rate (lb ai/A) | TTR (ug/cm 2) | At Edge | 10 Feet | 25 Feet | 50 Feet | 75 Feet | 100 Feet | 125 Feet | 150 Feet | 200 Feet | 250 Feet | 300 Feet |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Fencerows and Hedgerows | | | | | | | | | | | | | | |
| | ***Fine to Medium*** | | | 28 | 35 | 43 | 56 | 74 | 95 | 120 | 130 | 180 | 210 | 260 |
| | Medium to Coarse | | | 34 | 46 | 63 | 88 | 130 | 160 | 210 | 250 | 350 | 450 | 560 |
| | Coarse to Very Coarse | | | 40 | 58 | 88 | 140 | 200 | 260 | 330 | 400 | 560 | 730 | 910 |
| | Very Fine to Fine | | | 19 | 21 | 24 | 28 | 32 | 37 | 41 | 47 | 57 | 67 | 76 |
| Aerial | AT401, M, 10 mph, 37% SD | | | 31 | 40 | 51 | 69 | 93 | 120 | 150 | 170 | 230 | 280 | 350 |
| | WASP, M, 10 mph, 37% SD | | | 33 | 42 | 56 | 84 | 120 | 150 | 180 | 210 | 280 | 350 | 400 |
| | AT401, C, 10 mph, 25% SD | | | 37 | 51 | 73 | 110 | 150 | 200 | 250 | 300 | 430 | 560 | 660 |
| | WASP, C, 10 mph, 25% SD | | | 42 | 60 | 86 | 140 | 190 | 260 | 320 | 400 | 560 | 730 | 810 |
| | AT401, VC, 10 mph, 20% SD | 10.6 | 2.8 | 41 | 63 | 100 | 160 | 230 | 320 | 400 | 520 | 730 | 910 | 1,200 |
| | WASP, VC, 10 mph, 20% SD | | | 53 | 82 | 130 | 200 | 290 | 380 | 520 | 600 | 910 | 1,000 | 1,200 |
| | ***High Boom Very fine to Fine*** | | | 39 | 78 | 130 | 210 | 290 | 360 | 430 | 520 | 660 | 910 | 1,000 |
| Groundboom | Low Boom Very fine to Fine | | | 85 | 230 | 360 | 560 | 730 | 910 | 1,000 | 1,200 | 1,500 | 1,800 | 2,400 |
| | High Boom Fine to Medium/Coarse | | | 150 | 380 | 560 | 810 | 1,000 | 1,200 | 1,500 | 1,500 | 1,800 | 2,400 | 2,400 |
| | Low Boom Fine to Medium/Coarse | | | 220 | 600 | 910 | 1,200 | 1,500 | 1,800 | 2,400 | 2,400 | 3,600 | 3,600 | 3,600 |
| | ***Sparse*** | | | 51 | 87 | 160 | 360 | 660 | 1,100 | 1,600 | 2,300 | 4,000 | 6,600 | 9,100 |
| | Normal | | | 2,400 | 3,600 | 5,600 | 8,100 | 12,000 | 15,000 | 18,000 | 24,000 | 24,000 | 36,000 | 36,000 |
| Airblast | Dense | | | 170 | 260 | 410 | 730 | 1,100 | 1,500 | 1,900 | 2,300 | 3,200 | 4,000 | 4,800 |
| | Vineyard | | | 910 | 1,800 | 3,300 | 6,000 | 9,100 | 12,000 | 15,000 | 18,000 | 24,000 | 36,000 | 36,000 |
| Citrus (CA) | | | | | | | | | | | | | | |
| Aerial | ***Fine to Medium*** | 7.5 | 2.0 | 40 | 49 | 61 | 79 | 100 | 130 | 160 | 190 | 250 | 300 | 370 |
| | Medium to Coarse | | | 49 | 66 | 89 | 120 | 180 | 230 | 290 | 350 | 490 | 640 | 790 |

**Table E.1. Adult Risk Estimates (MOEs) Related to Indirect Exposure to Spray Drift for Malathion for the Dermal Route of Exposure**

| Crop/Rate Group | Spray Type/ Nozzle Configuration | Appl. Rate (lb ai/A) | TTR (ug/cm 2) | At Edge | 10 Feet | 25 Feet | 50 Feet | 75 Feet | 100 Feet | 125 Feet | 150 Feet | 200 Feet | 250 Feet | 300 Feet |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Groundboom | Coarse to Very Coarse | | | 56 | 83 | 120 | 190 | 280 | 370 | 470 | 570 | 790 | 1,000 | 1,300 |
| | Very Fine to Fine | | | 27 | 30 | 34 | 39 | 45 | 52 | 59 | 66 | 81 | 95 | 110 |
| | AT401, M, 10 mph, 37% SD | | | 44 | 56 | 72 | 98 | 130 | 170 | 210 | 240 | 320 | 390 | 490 |
| | WASP, M, 10 mph, 37% SD | | | 47 | 60 | 79 | 120 | 160 | 210 | 260 | 300 | 390 | 490 | 570 |
| | AT401, C, 10 mph, 25% SD | | | 52 | 73 | 100 | 150 | 220 | 280 | 350 | 430 | 600 | 790 | 930 |
| | WASP, C, 10 mph, 25% SD | | | 60 | 85 | 120 | 190 | 270 | 370 | 450 | 570 | 790 | 1,000 | 1,100 |
| | AT401, VC, 10 mph, 20% SD | | | 59 | 89 | 140 | 230 | 330 | 450 | 570 | 730 | 1,000 | 1,300 | 1,700 |
| | WASP, VC, 10 mph, 20% SD | | | 74 | 120 | 180 | 280 | 410 | 540 | 730 | 850 | 1,300 | 1,500 | 1,700 |
| | ***High Boom Very fine to Fine*** | | | 55 | 110 | 180 | 290 | 410 | 510 | 600 | 730 | 930 | 1,300 | 1,500 |
| | Low Boom Very fine to Fine | | | 120 | 320 | 510 | 790 | 1,000 | 1,300 | 1,500 | 1,700 | 2,000 | 2,600 | 3,400 |
| | High Boom Fine to Medium/Coarse | | | 210 | 540 | 790 | 1,100 | 1,500 | 1,700 | 2,000 | 2,000 | 2,600 | 3,400 | 3,400 |
| | Low Boom Fine to Medium/Coarse | | | 310 | 850 | 1,300 | 1,700 | 2,000 | 2,600 | 3,400 | 3,400 | 5,100 | 5,100 | 5,100 |
| Airblast | ***Sparse*** | | | 71 | 120 | 230 | 510 | 930 | 1,500 | 2,300 | 3,200 | 5,700 | 9,300 | 13,000 |
| | Normal | | | 3,400 | 5,100 | 7,900 | 11,000 | 17,000 | 20,000 | 26,000 | 34,000 | 34,000 | 51,000 | 51,000 |
| | Dense | | | 240 | 370 | 590 | 1,000 | 1,500 | 2,100 | 2,600 | 3,200 | 4,500 | 5,700 | 6,800 |
| | Vineyard | | | 1,300 | 2,500 | 4,700 | 8,500 | 13,000 | 17,000 | 20,000 | 26,000 | 34,000 | 51,000 | 51,000 |
| Kumquats, Citrus (including FL, except lemon in FL) | | | | | | | | | | | | | | |
| Aerial | ***Fine to Medium*** | 4.5 | 1.2 | 66 | 82 | 100 | 130 | 170 | 220 | 270 | 320 | 420 | 500 | 610 |
| | Medium to Coarse | | | 81 | 110 | 150 | 210 | 290 | 390 | 490 | 590 | 810 | 1,100 | 1,300 |
| | Coarse to Very Coarse | | | 93 | 140 | 210 | 320 | 460 | 610 | 780 | 950 | 1,300 | 1,700 | 2,100 |
| | Very Fine to Fine | | | 46 | 50 | 56 | 65 | 76 | 87 | 98 | 110 | 130 | 160 | 180 |
| | AT401, M, 10 mph, 37% SD | | | 73 | 93 | 120 | 160 | 220 | 280 | 350 | 410 | 530 | 660 | 810 |

**Table E.1. Adult Risk Estimates (MOEs) Related to Indirect Exposure to Spray Drift for Malathion for the Dermal Route of Exposure**

| Crop/Rate Group | Spray Type/ Nozzle Configuration | Appl. Rate (lb ai/A) | TTR (ug/cm 2) | At Edge | 10 Feet | 25 Feet | 50 Feet | 75 Feet | 100 Feet | 125 Feet | 150 Feet | 200 Feet | 250 Feet | 300 Feet |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Groundboom | WASP, M, 10 mph, 37% SD | 3 | 0.80 | 78 | 100 | 130 | 200 | 270 | 350 | 430 | 500 | 660 | 810 | 950 |
| | AT401, C, 10 mph, 25% SD | | | 86 | 120 | 170 | 250 | 360 | 470 | 590 | 710 | 1,000 | 1,300 | 1,600 |
| | WASP, C, 10 mph, 25% SD | | | 100 | 140 | 200 | 320 | 450 | 610 | 740 | 950 | 1,300 | 1,700 | 1,900 |
| | AT401, VC, 10 mph, 20% SD | | | 98 | 150 | 240 | 390 | 550 | 740 | 950 | 1,200 | 1,700 | 2,100 | 2,800 |
| | WASP, VC, 10 mph, 20% SD | | | 120 | 190 | 300 | 470 | 680 | 900 | 1,200 | 1,400 | 2,100 | 2,400 | 2,800 |
| | ***High Boom Very fine to Fine*** | | | 91 | 180 | 310 | 490 | 680 | 850 | 1,000 | 1,200 | 1,600 | 2,100 | 2,400 |
| | Low Boom Very fine to Fine | | | 200 | 530 | 850 | 1,300 | 1,700 | 2,100 | 2,400 | 2,800 | 3,400 | 4,300 | 5,700 |
| | High Boom Fine to Medium/Coarse | | | 350 | 900 | 1,300 | 1,900 | 2,400 | 2,800 | 3,400 | 3,400 | 4,300 | 5,700 | 5,700 |
| | Low Boom Fine to Medium/Coarse | | | 520 | 1,400 | 2,100 | 2,800 | 3,400 | 4,300 | 5,700 | 5,700 | 8,500 | 8,500 | 8,500 |
| Airblast | ***Sparse*** | | | 120 | 200 | 390 | 850 | 1,600 | 2,500 | 3,800 | 5,300 | 9,500 | 16,000 | 21,000 |
| | Normal | | | 5,700 | 8,500 | 13,000 | 19,000 | 28,000 | 34,000 | 43,000 | 57,000 | 57,000 | 85,000 | 85,000 |
| | Dense | | | 400 | 610 | 980 | 1,700 | 2,500 | 3,500 | 4,400 | 5,300 | 7,400 | 9,500 | 11,000 |
| Nectarines, Peaches | Vineyard | | | 2,100 | 4,200 | 7,800 | 14,000 | 21,000 | 28,000 | 34,000 | 43,000 | 57,000 | 85,000 | 85,000 |
| Aerial | ***Fine to Medium*** | | | 100 | 120 | 150 | 200 | 260 | 340 | 410 | 470 | 620 | 750 | 920 |
| | Medium to Coarse | | | 120 | 160 | 220 | 310 | 440 | 580 | 730 | 880 | 1,200 | 1,600 | 2,000 |
| | Coarse to Very Coarse | | | 140 | 210 | 310 | 480 | 690 | 920 | 1,200 | 1,400 | 2,000 | 2,600 | 3,200 |
| | Very Fine to Fine | | | 69 | 75 | 84 | 98 | 110 | 130 | 150 | 170 | 200 | 240 | 270 |
| | AT401, M, 10 mph, 37% SD | | | 110 | 140 | 180 | 240 | 330 | 430 | 520 | 610 | 800 | 990 | 1,200 |
| | WASP, M, 10 mph, 37% SD | | | 120 | 150 | 200 | 300 | 410 | 520 | 640 | 750 | 990 | 1,200 | 1,400 |
| | AT401, C, 10 mph, 25% SD | | | 130 | 180 | 260 | 380 | 550 | 710 | 880 | 1,100 | 1,500 | 2,000 | 2,300 |
| | WASP, C, 10 mph, 25% SD | | | 150 | 210 | 310 | 480 | 670 | 920 | 1,100 | 1,400 | 2,000 | 2,600 | 2,800 |

**Table E.1. Adult Risk Estimates (MOEs) Related to Indirect Exposure to Spray Drift for Malathion for the Dermal Route of Exposure**

| Crop/Rate Group | Spray Type/ Nozzle Configuration | Appl. Rate (lb ai/A) | TTR (ug/cm 2) | At Edge | 10 Feet | 25 Feet | 50 Feet | 75 Feet | 100 Feet | 125 Feet | 150 Feet | 200 Feet | 250 Feet | 300 Feet |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Groundboom | AT401, VC, 10 mph, 20% SD | 2.5 | 0.66 | 150 | 220 | 360 | 580 | 830 | 1,100 | 1,400 | 1,800 | 2,600 | 3,200 | 4,300 |
| | WASP, VC, 10 mph, 20% SD | | | 190 | 290 | 450 | 710 | 1,000 | 1,300 | 1,800 | 2,100 | 3,200 | 3,700 | 4,300 |
| | ***High Boom Very fine to Fine*** | | | 140 | 280 | 460 | 730 | 1,000 | 1,300 | 1,500 | 1,800 | 2,300 | 3,200 | 3,700 |
| | Low Boom Very fine to Fine | | | 300 | 800 | 1,300 | 2,000 | 2,600 | 3,200 | 3,700 | 4,300 | 5,100 | 6,400 | 8,500 |
| | High Boom Fine to Medium/Coarse | | | 520 | 1,300 | 2,000 | 2,800 | 3,700 | 4,300 | 5,100 | 5,100 | 6,400 | 8,500 | 8,500 |
| | Low Boom Fine to Medium/Coarse | | | 780 | 2,100 | 3,200 | 4,300 | 5,100 | 6,400 | 8,500 | 8,500 | 13,000 | 13,000 | 13,000 |
| Airblast | ***Sparse*** | | | 180 | 310 | 580 | 1,300 | 2,300 | 3,800 | 5,700 | 8,000 | 14,000 | 23,000 | 32,000 |
| | Normal | | | 8,500 | 13,000 | 20,000 | 28,000 | 43,000 | 51,000 | 64,000 | 85,000 | 85,000 | 130,000 | 130,000 |
| | Dense | | | 610 | 920 | 1,500 | 2,600 | 3,800 | 5,200 | 6,600 | 8,000 | 11,000 | 14,000 | 17,000 |
| Chestnut, Cotton, Pecans, Walnut | Vineyard | | | 3,200 | 6,200 | 12,000 | 21,000 | 32,000 | 43,000 | 51,000 | 64,000 | 85,000 | 130,000 | 130,000 |
| Aerial | ***Fine to Medium*** | 2.5 | 0.66 | 120 | 150 | 180 | 240 | 310 | 400 | 490 | 570 | 750 | 900 | 1,100 |
| | Medium to Coarse | | | 150 | 200 | 270 | 370 | 530 | 700 | 880 | 1,100 | 1,500 | 1,900 | 2,400 |
| | Coarse to Very Coarse | | | 170 | 250 | 370 | 580 | 830 | 1,100 | 1,400 | 1,700 | 2,400 | 3,100 | 3,800 |
| | Very Fine to Fine | | | 82 | 90 | 100 | 120 | 140 | 160 | 180 | 200 | 240 | 280 | 320 |
| | AT401, M, 10 mph, 37% SD | | | 130 | 170 | 220 | 290 | 390 | 510 | 630 | 730 | 960 | 1,200 | 1,500 |
| | WASP, M, 10 mph, 37% SD | | | 140 | 180 | 240 | 360 | 490 | 630 | 770 | 900 | 1,200 | 1,500 | 1,700 |
| | AT401, C, 10 mph, 25% SD | | | 160 | 220 | 310 | 460 | 650 | 850 | 1,100 | 1,300 | 1,800 | 2,400 | 2,800 |
| | WASP, C, 10 mph, 25% SD | | | 180 | 250 | 370 | 580 | 810 | 1,100 | 1,300 | 1,700 | 2,400 | 3,100 | 3,400 |
| Groundboom | AT401, VC, 10 mph, 20% SD | | | 180 | 270 | 430 | 700 | 990 | 1,300 | 1,700 | 2,200 | 3,100 | 3,800 | 5,100 |
| | WASP, VC, 10 mph, 20% SD | | | 220 | 350 | 540 | 850 | 1,200 | 1,600 | 2,200 | 2,600 | 3,800 | 4,400 | 5,100 |
| | ***High Boom Very fine to Fine*** | | | 160 | 330 | 550 | 880 | 1,200 | 1,500 | 1,800 | 2,200 | 2,800 | 3,800 | 4,400 |

**Table E.1. Adult Risk Estimates (MOEs) Related to Indirect Exposure to Spray Drift for Malathion for the Dermal Route of Exposure**

| Crop/Rate Group | Spray Type/ Nozzle Configuration | Appl. Rate (lb ai/A) | TTR (ug/cm 2) | At Edge | 10 Feet | 25 Feet | 50 Feet | 75 Feet | 100 Feet | 125 Feet | 150 Feet | 200 Feet | 250 Feet | 300 Feet |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Airblast | Low Boom Very fine to Fine | 2.23 | 0.59 | 360 | 960 | 1,500 | 2,400 | 3,100 | 3,800 | 4,400 | 5,100 | 6,100 | 7,700 | 10,000 |
| | High Boom Fine to Medium/Coarse | | | 630 | 1,600 | 2,400 | 3,400 | 4,400 | 5,100 | 6,100 | 6,100 | 7,700 | 10,000 | 10,000 |
| | Low Boom Fine to Medium/Coarse | | | 930 | 2,600 | 3,800 | 5,100 | 6,100 | 7,700 | 10,000 | 10,000 | 15,000 | 15,000 | 15,000 |
| | ***Sparse*** | | | 210 | 370 | 690 | 1,500 | 2,800 | 4,500 | 6,800 | 9,600 | 17,000 | 28,000 | 38,000 |
| | Normal | | | 10,000 | 15,000 | 24,000 | 34,000 | 51,000 | 61,000 | 77,000 | 100,000 | 100,000 | 150,000 | 150,000 |
| | Dense | | | 730 | 1,100 | 1,800 | 3,100 | 4,600 | 6,300 | 7,900 | 9,600 | 13,000 | 17,000 | 20,000 |
| Apples | Vineyard | | | 3,800 | 7,500 | 14,000 | 26,000 | 38,000 | 51,000 | 61,000 | 77,000 | 100,000 | 150,000 | 150,000 |
| Aerial | ***Fine to Medium*** | | | 130 | 160 | 200 | 270 | 350 | 450 | 550 | 640 | 840 | 1,000 | 1,200 |
| | Medium to Coarse | | | 160 | 220 | 300 | 420 | 590 | 780 | 980 | 1,200 | 1,600 | 2,200 | 2,700 |
| | Coarse to Very Coarse | | | 190 | 280 | 420 | 650 | 930 | 1,200 | 1,600 | 1,900 | 2,700 | 3,400 | 4,300 |
| | Very Fine to Fine | | | 92 | 100 | 110 | 130 | 150 | 170 | 200 | 220 | 270 | 320 | 360 |
| | AT401, M, 10 mph, 37% SD | | | 150 | 190 | 240 | 330 | 440 | 570 | 700 | 820 | 1,100 | 1,300 | 1,600 |
| | WASP, M, 10 mph, 37% SD | | | 160 | 200 | 270 | 400 | 550 | 700 | 860 | 1,000 | 1,300 | 1,600 | 1,900 |
| | AT401, C, 10 mph, 25% SD | | | 170 | 240 | 350 | 510 | 730 | 960 | 1,200 | 1,400 | 2,000 | 2,700 | 3,100 |
| | WASP, C, 10 mph, 25% SD | | | 200 | 280 | 410 | 650 | 910 | 1,200 | 1,500 | 1,900 | 2,700 | 3,400 | 3,800 |
| | AT401, VC, 10 mph, 20% SD | | | 200 | 300 | 480 | 780 | 1,100 | 1,500 | 1,900 | 2,500 | 3,400 | 4,300 | 5,700 |
| | WASP, VC, 10 mph, 20% SD | | | 250 | 390 | 600 | 960 | 1,400 | 1,800 | 2,500 | 2,900 | 4,300 | 4,900 | 5,700 |
| Groundboom | ***High Boom Very fine to Fine*** | | | 180 | 370 | 620 | 980 | 1,400 | 1,700 | 2,000 | 2,500 | 3,100 | 4,300 | 4,900 |
| | Low Boom Very fine to Fine | | | 410 | 1,100 | 1,700 | 2,700 | 3,400 | 4,300 | 4,900 | 5,700 | 6,900 | 8,600 | 11,000 |
| | High Boom Fine to Medium/Coarse | | | 700 | 1,800 | 2,700 | 3,800 | 4,900 | 5,700 | 6,900 | 6,900 | 8,600 | 11,000 | 11,000 |
| | Low Boom Fine to Medium/Coarse | | | 1,000 | 2,900 | 4,300 | 5,700 | 6,900 | 8,600 | 11,000 | 11,000 | 17,000 | 17,000 | 17,000 |

**Table E.1. Adult Risk Estimates (MOEs) Related to Indirect Exposure to Spray Drift for Malathion for the Dermal Route of Exposure**

| Crop/Rate Group | Spray Type/ Nozzle Configuration | Appl. Rate (lb ai/A) | TTR (ug/cm 2) | At Edge | 10 Feet | 25 Feet | 50 Feet | 75 Feet | 100 Feet | 125 Feet | 150 Feet | 200 Feet | 250 Feet | 300 Feet |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Airblast | ***Sparse*** | 2 | 0.53 | 240 | 410 | 780 | 1,700 | 3,100 | 5,100 | 7,700 | 11,000 | 19,000 | 31,000 | 43,000 |
| | Normal | | | 11,000 | 17,000 | 27,000 | 38,000 | 57,000 | 69,000 | 86,000 | 110,000 | 110,000 | 170,000 | 170,000 |
| | Dense | | | 820 | 1,200 | 2,000 | 3,400 | 5,100 | 7,000 | 8,800 | 11,000 | 15,000 | 19,000 | 23,000 |
| | Vineyard | | | 4,300 | 8,400 | 16,000 | 29,000 | 43,000 | 57,000 | 69,000 | 86,000 | 110,000 | 170,000 | 170,000 |
| Arugula, Amaranth, Caneberries, Chervil, Chrysanthenmum, Corn salad, Dock(sorrel), Figs, Orach, Ornamentals, Purslane, Strawberries, Celtuce, Florence fennel, Gooseberry, Pineapple | | | | | | | | | | | | | | |
| Aerial | ***Fine to Medium*** | 2 | 0.53 | 150 | 180 | 230 | 300 | 390 | 510 | 610 | 710 | 940 | 1,100 | 1,400 |
| | Medium to Coarse | | | 180 | 250 | 330 | 470 | 660 | 870 | 1,100 | 1,300 | 1,800 | 2,400 | 3,000 |
| | Coarse to Very Coarse | | | 210 | 310 | 470 | 730 | 1,000 | 1,400 | 1,700 | 2,100 | 3,000 | 3,800 | 4,800 |
| | Very Fine to Fine | | | 100 | 110 | 130 | 150 | 170 | 200 | 220 | 250 | 300 | 360 | 400 |
| | AT401, M, 10 mph, 37% SD | | | 160 | 210 | 270 | 370 | 490 | 640 | 780 | 920 | 1,200 | 1,500 | 1,800 |
| | WASP, M, 10 mph, 37% SD | | | 180 | 220 | 300 | 450 | 610 | 780 | 960 | 1,100 | 1,500 | 1,800 | 2,100 |
| | AT401, C, 10 mph, 25% SD | | | 190 | 270 | 390 | 570 | 820 | 1,100 | 1,300 | 1,600 | 2,300 | 3,000 | 3,500 |
| | WASP, C, 10 mph, 25% SD | | | 220 | 320 | 460 | 730 | 1,000 | 1,400 | 1,700 | 2,100 | 3,000 | 3,800 | 4,300 |
| | AT401, VC, 10 mph, 20% SD | | | 220 | 330 | 530 | 870 | 1,200 | 1,700 | 2,100 | 2,700 | 3,800 | 4,800 | 6,400 |
| | WASP, VC, 10 mph, 20% SD | | | 280 | 440 | 670 | 1,100 | 1,500 | 2,000 | 2,700 | 3,200 | 4,800 | 5,500 | 6,400 |
| Groundboom | ***High Boom Very fine to Fine*** | | | 210 | 410 | 690 | 1,100 | 1,500 | 1,900 | 2,300 | 2,700 | 3,500 | 4,800 | 5,500 |
| | Low Boom Very fine to Fine | | | 450 | 1,200 | 1,900 | 3,000 | 3,800 | 4,800 | 5,500 | 6,400 | 7,700 | 9,600 | 13,000 |
| | High Boom Fine to Medium/Coarse | | | 780 | 2,000 | 3,000 | 4,300 | 5,500 | 6,400 | 7,700 | 7,700 | 9,600 | 13,000 | 13,000 |
| | Low Boom Fine to Medium/Coarse | | | 1,200 | 3,200 | 4,800 | 6,400 | 7,700 | 9,600 | 13,000 | 13,000 | 19,000 | 19,000 | 19,000 |
| Airblast | ***Sparse*** | 4 | 0.53 | 270 | 460 | 870 | 1,900 | 3,500 | 5,700 | 8,500 | 12,000 | 21,000 | 35,000 | 48,000 |
| | Normal | | | 13,000 | 19,000 | 30,000 | 43,000 | 64,000 | 77,000 | 96,000 | 130,000 | 130,000 | 190,000 | 190,000 |
| | Dense | | | 910 | 1,400 | 2,200 | 3,800 | 5,700 | 7,800 | 9,900 | 12,000 | 17,000 | 21,000 | 26,000 |

**Table E.1. Adult Risk Estimates (MOEs) Related to Indirect Exposure to Spray Drift for Malathion for the Dermal Route of Exposure**

| Crop/Rate Group | Spray Type/ Nozzle Configuration | Appl. Rate (lb ai/A) | TTR (ug/cm 2) | At Edge | 10 Feet | 25 Feet | 50 Feet | 75 Feet | 100 Feet | 125 Feet | 150 Feet | 200 Feet | 250 Feet | 300 Feet |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Chayote fruit, Cherries, Cucumber, Summer squash | Vineyard | | | 4,800 | 9,400 | 17,000 | 32,000 | 48,000 | 64,000 | 77,000 | 96,000 | 130,000 | 190,000 | 190,000 |
| Aerial | ***Fine to Medium*** | | | 170 | 210 | 260 | 340 | 450 | 580 | 700 | 810 | 1,100 | 1,300 | 1,600 |
| | Medium to Coarse | | | 210 | 280 | 380 | 540 | 760 | 1,000 | 1,300 | 1,500 | 2,100 | 2,700 | 3,400 |
| | Coarse to Very Coarse | | | 240 | 350 | 540 | 830 | 1,200 | 1,600 | 2,000 | 2,400 | 3,400 | 4,400 | 5,500 |
| | Very Fine to Fine | | | 120 | 130 | 140 | 170 | 190 | 220 | 250 | 280 | 350 | 410 | 460 |
| | AT401, M, 10 mph, 37% SD | | | 190 | 240 | 310 | 420 | 560 | 730 | 900 | 1,000 | 1,400 | 1,700 | 2,100 |
| | WASP, M, 10 mph, 37% SD | | | 200 | 260 | 340 | 510 | 700 | 900 | 1,100 | 1,300 | 1,700 | 2,100 | 2,400 |
| | AT401, C, 10 mph, 25% SD | | | 220 | 310 | 440 | 660 | 930 | 1,200 | 1,500 | 1,800 | 2,600 | 3,400 | 4,000 |
| | WASP, C, 10 mph, 25% SD | | | 260 | 360 | 520 | 830 | 1,200 | 1,600 | 1,900 | 2,400 | 3,400 | 4,400 | 4,900 |
| | AT401, VC, 10 mph, 20% SD | 1.75 | 0.47 | 250 | 380 | 610 | 1,000 | 1,400 | 1,900 | 2,400 | 3,100 | 4,400 | 5,500 | 7,300 |
| | WASP, VC, 10 mph, 20% SD | | | 320 | 500 | 770 | 1,200 | 1,800 | 2,300 | 3,100 | 3,700 | 5,500 | 6,300 | 7,300 |
| Groundboom | ***High Boom Very fine to Fine*** | | | 230 | 470 | 780 | 1,300 | 1,800 | 2,200 | 2,600 | 3,100 | 4,000 | 5,500 | 6,300 |
| | Low Boom Very fine to Fine | | | 520 | 1,400 | 2,200 | 3,400 | 4,400 | 5,500 | 6,300 | 7,300 | 8,800 | 11,000 | 15,000 |
| | High Boom Fine to Medium/Coarse | | | 900 | 2,300 | 3,400 | 4,900 | 6,300 | 7,300 | 8,800 | 8,800 | 11,000 | 15,000 | 15,000 |
| | Low Boom Fine to Medium/Coarse | | | 1,300 | 3,700 | 5,500 | 7,300 | 8,800 | 11,000 | 15,000 | 15,000 | 22,000 | 22,000 | 22,000 |
| Airblast | ***Sparse*** | | | 310 | 530 | 990 | 2,200 | 4,000 | 6,500 | 9,800 | 14,000 | 24,000 | 40,000 | 55,000 |
| | Normal | | | 15,000 | 22,000 | 34,000 | 49,000 | 73,000 | 88,000 | 110,000 | 150,000 | 150,000 | 220,000 | 220,000 |
| | Dense | | | 1,000 | 1,600 | 2,500 | 4,400 | 6,600 | 9,000 | 11,000 | 14,000 | 19,000 | 24,000 | 29,000 |
| Chayote root, Eggplant, Garlic, Leeks, Onions, Peppers, Bell Peppers, Potatoes, Shallots, Sweet potatoes, Tomatoes, Yams | Vineyard | | | 5,500 | 11,000 | 20,000 | 37,000 | 55,000 | 73,000 | 88,000 | 110,000 | 150,000 | 220,000 | 220,000 |
| Aerial | ***Fine to Medium*** | 1.56 | 0.41 | 190 | 240 | 290 | 380 | 500 | 650 | 780 | 910 | 1,200 | 1,400 | 1,800 |

**Table E.1. Adult Risk Estimates (MOEs) Related to Indirect Exposure to Spray Drift for Malathion for the Dermal Route of Exposure**

| Crop/Rate Group | Spray Type/ Nozzle Configuration | Appl. Rate (lb ai/A) | TTR (ug/cm 2) | At Edge | 10 Feet | 25 Feet | 50 Feet | 75 Feet | 100 Feet | 125 Feet | 150 Feet | 200 Feet | 250 Feet | 300 Feet |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Groundboom | Medium to Coarse | | | 230 | 320 | 430 | 600 | 850 | 1,100 | 1,400 | 1,700 | 2,300 | 3,100 | 3,800 |
| | Coarse to Very Coarse | | | 270 | 400 | 600 | 930 | 1,300 | 1,800 | 2,200 | 2,700 | 3,800 | 4,900 | 6,200 |
| | Very Fine to Fine | | | 130 | 140 | 160 | 190 | 220 | 250 | 280 | 320 | 390 | 460 | 520 |
| | AT401, M, 10 mph, 37% SD | | | 210 | 270 | 350 | 470 | 630 | 820 | 1,000 | 1,200 | 1,500 | 1,900 | 2,300 |
| | WASP, M, 10 mph, 37% SD | | | 230 | 290 | 380 | 570 | 780 | 1,000 | 1,200 | 1,400 | 1,900 | 2,300 | 2,700 |
| | AT401, C, 10 mph, 25% SD | | | 250 | 350 | 500 | 740 | 1,000 | 1,400 | 1,700 | 2,100 | 2,900 | 3,800 | 4,500 |
| | WASP, C, 10 mph, 25% SD | | | 290 | 410 | 590 | 930 | 1,300 | 1,800 | 2,100 | 2,700 | 3,800 | 4,900 | 5,500 |
| | AT401, VC, 10 mph, 20% SD | | | 280 | 430 | 680 | 1,100 | 1,600 | 2,100 | 2,700 | 3,500 | 4,900 | 6,200 | 8,200 |
| | WASP, VC, 10 mph, 20% SD | | | 360 | 560 | 860 | 1,400 | 2,000 | 2,600 | 3,500 | 4,100 | 6,200 | 7,000 | 8,200 |
| | ***High Boom Very fine to Fine*** | | | 260 | 530 | 880 | 1,400 | 2,000 | 2,500 | 2,900 | 3,500 | 4,500 | 6,200 | 7,000 |
| | Low Boom Very fine to Fine | | | 580 | 1,500 | 2,500 | 3,800 | 4,900 | 6,200 | 7,000 | 8,200 | 9,900 | 12,000 | 16,000 |
| | High Boom Fine to Medium/Coarse | | | 1,000 | 2,600 | 3,800 | 5,500 | 7,000 | 8,200 | 9,900 | 9,900 | 12,000 | 16,000 | 16,000 |
| | Low Boom Fine to Medium/Coarse | | | 1,500 | 4,100 | 6,200 | 8,200 | 9,900 | 12,000 | 16,000 | 16,000 | 25,000 | 25,000 | 25,000 |
| Airblast | ***Sparse*** | | | 340 | 590 | 1,100 | 2,500 | 4,500 | 7,200 | 11,000 | 15,000 | 27,000 | 45,000 | 62,000 |
| | Normal | | | 16,000 | 25,000 | 38,000 | 55,000 | 82,000 | 99,000 | 120,000 | 160,000 | 160,000 | 250,000 | 250,000 |
| | Dense | | | 1,200 | 1,800 | 2,800 | 4,900 | 7,400 | 10,000 | 13,000 | 15,000 | 21,000 | 27,000 | 33,000 |
| | Vineyard | | | 6,200 | 12,000 | 22,000 | 41,000 | 62,000 | 82,000 | 99,000 | 120,000 | 160,000 | 250,000 | 250,000 |
| Apricot, Beans, Celery, Lentils, Parsley, Tangerines, Watermelon, | | | | | | | | | | | | | | |
| Aerial | ***Fine to Medium*** | 1.5 | 0.40 | 200 | 250 | 300 | 400 | 520 | 670 | 810 | 950 | 1,200 | 1,500 | 1,800 |
| | Medium to Coarse | | | 240 | 330 | 450 | 620 | 880 | 1,200 | 1,500 | 1,800 | 2,400 | 3,200 | 3,900 |
| | Coarse to Very Coarse | | | 280 | 410 | 620 | 970 | 1,400 | 1,800 | 2,300 | 2,800 | 3,900 | 5,100 | 6,400 |
| | Very Fine to Fine | | | 140 | 150 | 170 | 200 | 230 | 260 | 290 | 330 | 400 | 470 | 540 |

**Table E.1. Adult Risk Estimates (MOEs) Related to Indirect Exposure to Spray Drift for Malathion for the Dermal Route of Exposure**

| Crop/Rate Group | Spray Type/ Nozzle Configuration | Appl. Rate (lb ai/A) | TTR (ug/cm 2) | At Edge | 10 Feet | 25 Feet | 50 Feet | 75 Feet | 100 Feet | 125 Feet | 150 Feet | 200 Feet | 250 Feet | 300 Feet |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Groundboom | AT401, M, 10 mph, 37% SD | | | 220 | 280 | 360 | 490 | 660 | 850 | 1,000 | 1,200 | 1,600 | 2,000 | 2,400 |
| | WASP, M, 10 mph, 37% SD | | | 240 | 300 | 400 | 600 | 810 | 1,000 | 1,300 | 1,500 | 2,000 | 2,400 | 2,800 |
| | AT401, C, 10 mph, 25% SD | | | 260 | 360 | 520 | 760 | 1,100 | 1,400 | 1,800 | 2,100 | 3,000 | 3,900 | 4,700 |
| | WASP, C, 10 mph, 25% SD | | | 300 | 420 | 610 | 970 | 1,300 | 1,800 | 2,200 | 2,800 | 3,900 | 5,100 | 5,700 |
| | AT401, VC, 10 mph, 20% SD | | | 290 | 450 | 710 | 1,200 | 1,700 | 2,200 | 2,800 | 3,700 | 5,100 | 6,400 | 8,500 |
| | WASP, VC, 10 mph, 20% SD | | | 370 | 580 | 900 | 1,400 | 2,000 | 2,700 | 3,700 | 4,300 | 6,400 | 7,300 | 8,500 |
| | ***High Boom Very fine to Fine*** | | | 270 | 550 | 920 | 1,500 | 2,000 | 2,600 | 3,000 | 3,700 | 4,700 | 6,400 | 7,300 |
| | Low Boom Very fine to Fine | | | 600 | 1,600 | 2,600 | 3,900 | 5,100 | 6,400 | 7,300 | 8,500 | 10,000 | 13,000 | 17,000 |
| | High Boom Fine to Medium/Coarse | | | 1,000 | 2,700 | 3,900 | 5,700 | 7,300 | 8,500 | 10,000 | 10,000 | 13,000 | 17,000 | 17,000 |
| | Low Boom Fine to Medium/Coarse | | | 1,600 | 4,300 | 6,400 | 8,500 | 10,000 | 13,000 | 17,000 | 17,000 | 26,000 | 26,000 | 26,000 |
| Airblast | ***Sparse*** | | | 360 | 610 | 1,200 | 2,600 | 4,700 | 7,500 | 11,000 | 16,000 | 28,000 | 47,000 | 64,000 |
| | Normal | | | 17,000 | 26,000 | 39,000 | 57,000 | 85,000 | 100,000 | 130,000 | 170,000 | 170,000 | 260,000 | 260,000 |
| | Dense | | | 1,200 | 1,800 | 2,900 | 5,100 | 7,600 | 10,000 | 13,000 | 16,000 | 22,000 | 28,000 | 34,000 |
| | Vineyard | | | 6,400 | 12,000 | 23,000 | 43,000 | 64,000 | 85,000 | 100,000 | 130,000 | 170,000 | 260,000 | 260,000 |
| Alfalfa, Asparagus, Barley, Beets, Broccoli, Brussel Sprouts, Cabbage, Carrot, Cauliflower, Chinese greens, Clover, Currant, Dandelion, Endive, Bermuda Grass, Forage and hay grass, Guava, Horseradish, Kohlrabi, Lemons (FL), Lespedeza, Papaya, Parsnip, Pears, Rice, Salsify, Trefoil, Turnips, Vetch, Watercress, Wild Rice | | | | | | | | | | | | | | |
| Aerial | ***Fine to Medium*** | 1.25 | 0.33 | 240 | 290 | 360 | 480 | 630 | 810 | 980 | 1,100 | 1,500 | 1,800 | 2,200 |
| | Medium to Coarse | | | 290 | 390 | 530 | 750 | 1,100 | 1,400 | 1,800 | 2,100 | 2,900 | 3,800 | 4,700 |
| | Coarse to Very Coarse | | | 340 | 500 | 750 | 1,200 | 1,700 | 2,200 | 2,800 | 3,400 | 4,700 | 6,100 | 7,700 |
| | Very Fine to Fine | | | 160 | 180 | 200 | 230 | 270 | 310 | 350 | 400 | 480 | 570 | 650 |
| | AT401, M, 10 mph, 37% SD | | | 260 | 340 | 430 | 590 | 790 | 1,000 | 1,300 | 1,500 | 1,900 | 2,400 | 2,900 |
| | WASP, M, 10 mph, 37% SD | | | 280 | 360 | 480 | 720 | 980 | 1,300 | 1,500 | 1,800 | 2,400 | 2,900 | 3,400 |

**Table E.1. Adult Risk Estimates (MOEs) Related to Indirect Exposure to Spray Drift for Malathion for the Dermal Route of Exposure**

| Crop/Rate Group | Spray Type/ Nozzle Configuration | Appl. Rate (lb ai/A) | TTR (ug/cm 2) | At Edge | 10 Feet | 25 Feet | 50 Feet | 75 Feet | 100 Feet | 125 Feet | 150 Feet | 200 Feet | 250 Feet | 300 Feet |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Groundboom | AT401, C, 10 mph, 25% SD | | | 310 | 440 | 620 | 920 | 1,300 | 1,700 | 2,100 | 2,600 | 3,600 | 4,700 | 5,600 |
| | WASP, C, 10 mph, 25% SD | | | 360 | 510 | 730 | 1,200 | 1,600 | 2,200 | 2,700 | 3,400 | 4,700 | 6,100 | 6,800 |
| | AT401, VC, 10 mph, 20% SD | | | 350 | 530 | 850 | 1,400 | 2,000 | 2,700 | 3,400 | 4,400 | 6,100 | 7,700 | 10,000 |
| | WASP, VC, 10 mph, 20% SD | | | 450 | 700 | 1,100 | 1,700 | 2,500 | 3,200 | 4,400 | 5,100 | 7,700 | 8,800 | 10,000 |
| | ***High Boom Very fine to Fine*** | | | 330 | 660 | 1,100 | 1,800 | 2,500 | 3,100 | 3,600 | 4,400 | 5,600 | 7,700 | 8,800 |
| | Low Boom Very fine to Fine | | | 720 | 1,900 | 3,100 | 4,700 | 6,100 | 7,700 | 8,800 | 10,000 | 12,000 | 15,000 | 20,000 |
| | High Boom Fine to Medium/Coarse | | | 1,300 | 3,200 | 4,700 | 6,800 | 8,800 | 10,000 | 12,000 | 12,000 | 15,000 | 20,000 | 20,000 |
| | Low Boom Fine to Medium/Coarse | | | 1,900 | 5,100 | 7,700 | 10,000 | 12,000 | 15,000 | 20,000 | 20,000 | 31,000 | 31,000 | 31,000 |
| Airblast | ***Sparse*** | | | 430 | 740 | 1,400 | 3,100 | 5,600 | 9,000 | 14,000 | 19,000 | 34,000 | 56,000 | 77,000 |
| | Normal | | | 20,000 | 31,000 | 47,000 | 68,000 | 100,000 | 120,000 | 150,000 | 200,000 | 200,000 | 310,000 | 310,000 |
| | Dense | | | 1,500 | 2,200 | 3,500 | 6,100 | 9,200 | 13,000 | 16,000 | 19,000 | 27,000 | 34,000 | 41,000 |
| | Vineyard | | | 7,700 | 15,000 | 28,000 | 51,000 | 77,000 | 100,000 | 120,000 | 150,000 | 200,000 | 310,000 | 310,000 |
| Cotton - Boll Weevil Eradication | | | | | | | | | | | | | | |
| Aerial | Very Fine to Fine | 1.22 | 0.32 | 170 | 190 | 210 | 240 | 280 | 320 | 360 | 410 | 500 | 580 | 660 |
| Chayote root, Eggplant, Garlic, Leeks, Onions, Peppers, Bell Peppers, Potatoes, Shallots, Sweet potatoes, Tomatoes, Yams | | | | | | | | | | | | | | |
| Aerial | ***Fine to Medium*** | 1 | 0.27 | 300 | 370 | 450 | 600 | 780 | 1,000 | 1,200 | 1,400 | 1,900 | 2,300 | 2,700 |
| | Medium to Coarse | | | 360 | 490 | 670 | 940 | 1,300 | 1,700 | 2,200 | 2,700 | 3,700 | 4,800 | 5,900 |
| | Coarse to Very Coarse | | | 420 | 620 | 940 | 1,500 | 2,100 | 2,700 | 3,500 | 4,300 | 5,900 | 7,700 | 9,600 |
| | Very Fine to Fine | | | 210 | 230 | 250 | 290 | 340 | 390 | 440 | 500 | 610 | 710 | 810 |
| | AT401, M, 10 mph, 37% SD | | | 330 | 420 | 540 | 730 | 990 | 1,300 | 1,600 | 1,800 | 2,400 | 3,000 | 3,700 |
| | WASP, M, 10 mph, 37% SD | | | 350 | 450 | 600 | 890 | 1,200 | 1,600 | 1,900 | 2,300 | 3,000 | 3,700 | 4,300 |
| | AT401, C, 10 mph, 25% SD | | | 390 | 550 | 780 | 1,100 | 1,600 | 2,100 | 2,700 | 3,200 | 4,500 | 5,900 | 7,000 |

**Table E.1. Adult Risk Estimates (MOEs) Related to Indirect Exposure to Spray Drift for Malathion for the Dermal Route of Exposure**

| Crop/Rate Group | Spray Type/ Nozzle Configuration | Appl. Rate (lb ai/A) | TTR (ug/cm 2) | At Edge | 10 Feet | 25 Feet | 50 Feet | 75 Feet | 100 Feet | 125 Feet | 150 Feet | 200 Feet | 250 Feet | 300 Feet |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Groundboom | WASP, C, 10 mph, 25% SD | | | 450 | 640 | 920 | 1,500 | 2,000 | 2,700 | 3,300 | 4,300 | 5,900 | 7,700 | 8,500 |
| | AT401, VC, 10 mph, 20% SD | | | 440 | 670 | 1,100 | 1,700 | 2,500 | 3,300 | 4,300 | 5,500 | 7,700 | 9,600 | 13,000 |
| | WASP, VC, 10 mph, 20% SD | | | 560 | 870 | 1,300 | 2,100 | 3,100 | 4,000 | 5,500 | 6,400 | 9,600 | 11,000 | 13,000 |
| | ***High Boom Very fine to Fine*** | | | 410 | 830 | 1,400 | 2,200 | 3,100 | 3,800 | 4,500 | 5,500 | 7,000 | 9,600 | 11,000 |
| | Low Boom Very fine to Fine | | | 900 | 2,400 | 3,800 | 5,900 | 7,700 | 9,600 | 11,000 | 13,000 | 15,000 | 19,000 | 26,000 |
| | High Boom Fine to Medium/Coarse | | | 1,600 | 4,000 | 5,900 | 8,500 | 11,000 | 13,000 | 15,000 | 15,000 | 19,000 | 26,000 | 26,000 |
| | Low Boom Fine to Medium/Coarse | | | 2,300 | 6,400 | 9,600 | 13,000 | 15,000 | 19,000 | 26,000 | 26,000 | 38,000 | 38,000 | 38,000 |
| | ***Sparse*** | | | 540 | 920 | 1,700 | 3,800 | 7,000 | 11,000 | 17,000 | 24,000 | 43,000 | 70,000 | 96,000 |
| Airblast | Normal | | | 26,000 | 38,000 | 59,000 | 85,000 | 130,000 | 150,000 | 190,000 | 260,000 | 260,000 | 380,000 | 380,000 |
| | Dense | | | 1,800 | 2,800 | 4,400 | 7,700 | 11,000 | 16,000 | 20,000 | 24,000 | 33,000 | 43,000 | 51,000 |
| | Vineyard | | | 9,600 | 19,000 | 35,000 | 64,000 | 96,000 | 130,000 | 150,000 | 190,000 | 260,000 | 380,000 | 380,000 |
| Blueberry (high and low bush) | | | | | | | | | | | | | | |
| Aerial | ***Fine to Medium*** | 0.77 | 0.20 | 390 | 480 | 590 | 770 | 1,000 | 1,300 | 1,600 | 1,800 | 2,400 | 2,900 | 3,600 |
| | Medium to Coarse | | | 470 | 640 | 870 | 1,200 | 1,700 | 2,300 | 2,900 | 3,400 | 4,800 | 6,200 | 7,700 |
| | Coarse to Very Coarse | | | 550 | 810 | 1,200 | 1,900 | 2,700 | 3,600 | 4,500 | 5,500 | 7,700 | 10,000 | 12,000 |
| | Very Fine to Fine | | | 270 | 290 | 330 | 380 | 440 | 510 | 570 | 640 | 790 | 920 | 1,100 |
| | AT401, M, 10 mph, 37% SD | | | 430 | 550 | 700 | 950 | 1,300 | 1,700 | 2,000 | 2,400 | 3,100 | 3,800 | 4,800 |
| | WASP, M, 10 mph, 37% SD | | | 460 | 580 | 770 | 1,200 | 1,600 | 2,000 | 2,500 | 2,900 | 3,800 | 4,800 | 5,500 |
| | AT401, C, 10 mph, 25% SD | | | 500 | 710 | 1,000 | 1,500 | 2,100 | 2,800 | 3,400 | 4,200 | 5,900 | 7,700 | 9,100 |
| | WASP, C, 10 mph, 25% SD | | | 580 | 830 | 1,200 | 1,900 | 2,600 | 3,600 | 4,300 | 5,500 | 7,700 | 10,000 | 11,000 |
| | AT401, VC, 10 mph, 20% SD | | | 570 | 870 | 1,400 | 2,300 | 3,200 | 4,300 | 5,500 | 7,100 | 10,000 | 12,000 | 17,000 |

**Table E.1. Adult Risk Estimates (MOEs) Related to Indirect Exposure to Spray Drift for Malathion for the Dermal Route of Exposure**

| Crop/Rate Group | Spray Type/ Nozzle Configuration | Appl. Rate (lb ai/A) | TTR (ug/cm 2) | At Edge | 10 Feet | 25 Feet | 50 Feet | 75 Feet | 100 Feet | 125 Feet | 150 Feet | 200 Feet | 250 Feet | 300 Feet |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Groundboom | WASP, VC, 10 mph, 20% SD | | | 720 | 1,100 | 1,800 | 2,800 | 4,000 | 5,300 | 7,100 | 8,300 | 12,000 | 14,000 | 17,000 |
| | ***High Boom Very fine to Fine*** | | | 530 | 1,100 | 1,800 | 2,900 | 4,000 | 5,000 | 5,900 | 7,100 | 9,100 | 12,000 | 14,000 |
| | Low Boom Very fine to Fine | | | 1,200 | 3,100 | 5,000 | 7,700 | 10,000 | 12,000 | 14,000 | 17,000 | 20,000 | 25,000 | 33,000 |
| | High Boom Fine to Medium/Coarse | | | 2,000 | 5,300 | 7,700 | 11,000 | 14,000 | 17,000 | 20,000 | 20,000 | 25,000 | 33,000 | 33,000 |
| | Low Boom Fine to Medium/Coarse | | | 3,000 | 8,300 | 12,000 | 17,000 | 20,000 | 25,000 | 33,000 | 33,000 | 50,000 | 50,000 | 50,000 |
| Airblast | ***Sparse*** | | | 700 | 1,200 | 2,300 | 5,000 | 9,100 | 15,000 | 22,000 | 31,000 | 55,000 | 91,000 | 120,000 |
| | Normal | | | 33,000 | 50,000 | 77,000 | 110,000 | 170,000 | 200,000 | 250,000 | 330,000 | 330,000 | 500,000 | 500,000 |
| | Dense | | | 2,400 | 3,600 | 5,700 | 10,000 | 15,000 | 20,000 | 26,000 | 31,000 | 43,000 | 55,000 | 67,000 |
| | Vineyard | | | 12,000 | 24,000 | 45,000 | 83,000 | 120,000 | 170,000 | 200,000 | 250,000 | 330,000 | 500,000 | 500,000 |
| Barley, Beans, Corn, Hops, Lespedeza, Lupine, Oats, Rice, Rye, Sorghum, Wheat, Citrus, USDA-APHIS Rangeland Grasshopper and Mormon Cricket Suppression Program | | | | | | | | | | | | | | |
| Aerial | ***Fine to Medium*** | 0.61 | 0.16 | 490 | 600 | 750 | 980 | 1,300 | 1,700 | 2,000 | 2,300 | 3,100 | 3,700 | 4,500 |
| | Medium to Coarse | | | 600 | 810 | 1,100 | 1,500 | 2,200 | 2,900 | 3,600 | 4,300 | 6,000 | 7,900 | 9,700 |
| | Coarse to Very Coarse | | | 690 | 1,000 | 1,500 | 2,400 | 3,400 | 4,500 | 5,700 | 7,000 | 9,700 | 13,000 | 16,000 |
| | Very Fine to Fine | | | 340 | 370 | 410 | 480 | 560 | 640 | 720 | 810 | 990 | 1,200 | 1,300 |
| | AT401, M, 10 mph, 37% SD | | | 540 | 690 | 890 | 1,200 | 1,600 | 2,100 | 2,600 | 3,000 | 3,900 | 4,800 | 6,000 |
| | WASP, M, 10 mph, 37% SD | | | 580 | 740 | 980 | 1,500 | 2,000 | 2,600 | 3,200 | 3,700 | 4,800 | 6,000 | 7,000 |
| | AT401, C, 10 mph, 25% SD | | | 640 | 890 | 1,300 | 1,900 | 2,700 | 3,500 | 4,300 | 5,300 | 7,400 | 9,700 | 11,000 |
| | WASP, C, 10 mph, 25% SD | | | 740 | 1,000 | 1,500 | 2,400 | 3,300 | 4,500 | 5,500 | 7,000 | 9,700 | 13,000 | 14,000 |
| | AT401, VC, 10 mph, 20% SD | | | 720 | 1,100 | 1,800 | 2,900 | 4,100 | 5,500 | 7,000 | 9,000 | 13,000 | 16,000 | 21,000 |
| | WASP, VC, 10 mph, 20% SD | | | 910 | 1,400 | 2,200 | 3,500 | 5,000 | 6,600 | 9,000 | 11,000 | 16,000 | 18,000 | 21,000 |

**Table E.1. Adult Risk Estimates (MOEs) Related to Indirect Exposure to Spray Drift for Malathion for the Dermal Route of Exposure**

| Crop/Rate Group | Spray Type/ Nozzle Configuration | Appl. Rate (lb ai/A) | TTR (ug/cm 2) | At Edge | 10 Feet | 25 Feet | 50 Feet | 75 Feet | 100 Feet | 125 Feet | 150 Feet | 200 Feet | 250 Feet | 300 Feet |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Groundboom | ***High Boom Very fine to Fine*** | 0.5 | 0.13 | 670 | 1,400 | 2,300 | 3,600 | 5,000 | 6,300 | 7,400 | 9,000 | 11,000 | 16,000 | 18,000 |
| | Low Boom Very fine to Fine | | | 1,500 | 3,900 | 6,300 | 9,700 | 13,000 | 16,000 | 18,000 | 21,000 | 25,000 | 32,000 | 42,000 |
| | High Boom Fine to Medium/Coarse | | | 2,600 | 6,600 | 9,700 | 14,000 | 18,000 | 21,000 | 25,000 | 25,000 | 32,000 | 42,000 | 42,000 |
| | Low Boom Fine to Medium/Coarse | | | 3,800 | 11,000 | 16,000 | 21,000 | 25,000 | 32,000 | 42,000 | 42,000 | 63,000 | 63,000 | 63,000 |
| Airblast | ***Sparse*** | | | 880 | 1,500 | 2,800 | 6,300 | 11,000 | 19,000 | 28,000 | 39,000 | 70,000 | 110,000 | 160,000 |
| | Normal | | | 42,000 | 63,000 | 97,000 | 140,000 | 210,000 | 250,000 | 320,000 | 420,000 | 420,000 | 630,000 | 630,000 |
| | Dense | | | 3,000 | 4,500 | 7,200 | 13,000 | 19,000 | 26,000 | 32,000 | 39,000 | 55,000 | 70,000 | 84,000 |
| | Vineyard | | | 16,000 | 31,000 | 57,000 | 110,000 | 160,000 | 210,000 | 250,000 | 320,000 | 420,000 | 630,000 | 630,000 |
| Flax | ***Fine to Medium*** | | | 600 | 740 | 910 | 1,200 | 1,600 | 2,000 | 2,400 | 2,800 | 3,700 | 4,500 | 5,500 |
| | Medium to Coarse | | | 730 | 990 | 1,300 | 1,900 | 2,700 | 3,500 | 4,400 | 5,300 | 7,300 | 9,600 | 12,000 |
| | Coarse to Very Coarse | | | 840 | 1,200 | 1,900 | 2,900 | 4,200 | 5,500 | 7,000 | 8,500 | 12,000 | 15,000 | 19,000 |
| | Very Fine to Fine | | | 410 | 450 | 500 | 590 | 680 | 780 | 880 | 990 | 1,200 | 1,400 | 1,600 |
| Aerial | AT401, M, 10 mph, 37% SD | | | 660 | 840 | 1,100 | 1,500 | 2,000 | 2,600 | 3,100 | 3,700 | 4,800 | 5,900 | 7,300 |
| | WASP, M, 10 mph, 37% SD | | | 710 | 900 | 1,200 | 1,800 | 2,400 | 3,100 | 3,800 | 4,500 | 5,900 | 7,300 | 8,500 |
| | AT401, C, 10 mph, 25% SD | | | 780 | 1,100 | 1,600 | 2,300 | 3,300 | 4,300 | 5,300 | 6,400 | 9,000 | 12,000 | 14,000 |
| | WASP, C, 10 mph, 25% SD | | | 900 | 1,300 | 1,800 | 2,900 | 4,000 | 5,500 | 6,700 | 8,500 | 12,000 | 15,000 | 17,000 |
| | AT401, VC, 10 mph, 20% SD | | | 880 | 1,300 | 2,100 | 3,500 | 5,000 | 6,700 | 8,500 | 11,000 | 15,000 | 19,000 | 26,000 |
| | WASP, VC, 10 mph, 20% SD | | | 1,100 | 1,700 | 2,700 | 4,300 | 6,100 | 8,100 | 11,000 | 13,000 | 19,000 | 22,000 | 26,000 |
| Groundboom | ***High Boom Very fine to Fine*** | | | 820 | 1,700 | 2,700 | 4,400 | 6,100 | 7,700 | 9,000 | 11,000 | 14,000 | 19,000 | 22,000 |
| | Low Boom Very fine to Fine | | | 1,800 | 4,800 | 7,700 | 12,000 | 15,000 | 19,000 | 22,000 | 26,000 | 31,000 | 38,000 | 51,000 |

**Table E.1. Adult Risk Estimates (MOEs) Related to Indirect Exposure to Spray Drift for Malathion for the Dermal Route of Exposure**

| Crop/Rate Group | Spray Type/ Nozzle Configuration | Appl. Rate (lb ai/A) | TTR (ug/cm 2) | At Edge | 10 Feet | 25 Feet | 50 Feet | 75 Feet | 100 Feet | 125 Feet | 150 Feet | 200 Feet | 250 Feet | 300 Feet |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Airblast | High Boom Fine to Medium/Coarse | 0.18 | 0.05 | 3,100 | 8,100 | 12,000 | 17,000 | 22,000 | 26,000 | 31,000 | 31,000 | 38,000 | 51,000 | 51,000 |
| | Low Boom Fine to Medium/Coarse | | | 4,700 | 13,000 | 19,000 | 26,000 | 31,000 | 38,000 | 51,000 | 51,000 | 77,000 | 77,000 | 77,000 |
| | ***Sparse*** | | | 1,100 | 1,800 | 3,500 | 7,700 | 14,000 | 23,000 | 34,000 | 48,000 | 85,000 | 140,000 | 190,000 |
| | Normal | | | 51,000 | 77,000 | 120,000 | 170,000 | 260,000 | 310,000 | 380,000 | 510,000 | 510,000 | 770,000 | 770,000 |
| | Dense | | | 3,600 | 5,500 | 8,800 | 15,000 | 23,000 | 31,000 | 39,000 | 48,000 | 67,000 | 85,000 | 100,000 |
| | Vineyard | | | 19,000 | 37,000 | 70,000 | 130,000 | 190,000 | 260,000 | 310,000 | 380,000 | 510,000 | 770,000 | 770,000 |
| Kumquat, Tangerines | | | | | | | | | | | | | | |
| Aerial | ***Fine to Medium*** | 0.18 | 0.05 | 1,700 | 2,000 | 2,500 | 3,300 | 4,400 | 5,600 | 6,800 | 7,900 | 10,000 | 13,000 | 15,000 |
| | Medium to Coarse | | | 2,000 | 2,700 | 3,700 | 5,200 | 7,400 | 9,700 | 12,000 | 15,000 | 20,000 | 27,000 | 33,000 |
| | Coarse to Very Coarse | | | 2,300 | 3,400 | 5,200 | 8,100 | 12,000 | 15,000 | 19,000 | 24,000 | 33,000 | 43,000 | 53,000 |
| | Very Fine to Fine | | | 1,100 | 1,300 | 1,400 | 1,600 | 1,900 | 2,200 | 2,400 | 2,800 | 3,400 | 4,000 | 4,500 |
| | AT401, M, 10 mph, 37% SD | | | 1,800 | 2,300 | 3,000 | 4,100 | 5,500 | 7,100 | 8,700 | 10,000 | 13,000 | 16,000 | 20,000 |
| | WASP, M, 10 mph, 37% SD | | | 2,000 | 2,500 | 3,300 | 5,000 | 6,800 | 8,700 | 11,000 | 13,000 | 16,000 | 20,000 | 24,000 |
| | AT401, C, 10 mph, 25% SD | | | 2,200 | 3,000 | 4,300 | 6,400 | 9,100 | 12,000 | 15,000 | 18,000 | 25,000 | 33,000 | 39,000 |
| | WASP, C, 10 mph, 25% SD | | | 2,500 | 3,500 | 5,100 | 8,100 | 11,000 | 15,000 | 19,000 | 24,000 | 33,000 | 43,000 | 47,000 |
| | AT401, VC, 10 mph, 20% SD | | | 2,400 | 3,700 | 5,900 | 9,700 | 14,000 | 19,000 | 24,000 | 31,000 | 43,000 | 53,000 | 71,000 |
| | WASP, VC, 10 mph, 20% SD | | | 3,100 | 4,900 | 7,500 | 12,000 | 17,000 | 22,000 | 31,000 | 36,000 | 53,000 | 61,000 | 71,000 |
| Groundboom | ***High Boom Very fine to Fine*** | | | 2,300 | 4,600 | 7,600 | 12,000 | 17,000 | 21,000 | 25,000 | 31,000 | 39,000 | 53,000 | 61,000 |
| | Low Boom Very fine to Fine | | | 5,000 | 13,000 | 21,000 | 33,000 | 43,000 | 53,000 | 61,000 | 71,000 | 85,000 | 110,000 | 140,000 |
| | High Boom Fine to Medium/Coarse | | | 8,700 | 22,000 | 33,000 | 47,000 | 61,000 | 71,000 | 85,000 | 85,000 | 110,000 | 140,000 | 140,000 |
| | Low Boom Fine to Medium/Coarse | | | 13,000 | 36,000 | 53,000 | 71,000 | 85,000 | 110,000 | 140,000 | 140,000 | 210,000 | 210,000 | 210,000 |

**Table E.1. Adult Risk Estimates (MOEs) Related to Indirect Exposure to Spray Drift for Malathion for the Dermal Route of Exposure**

| Crop/Rate Group | Spray Type/ Nozzle Configuration | Appl. Rate (lb ai/A) | TTR (ug/cm 2) | At Edge | 10 Feet | 25 Feet | 50 Feet | 75 Feet | 100 Feet | 125 Feet | 150 Feet | 200 Feet | 250 Feet | 300 Feet |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Airblast | ***Sparse*** | | | 3,000 | 5,100 | 9,600 | 21,000 | 39,000 | 63,000 | 95,000 | 130,000 | 240,000 | 390,000 | 530,000 |
| | Normal | | | 140,000 | 210,000 | 330,000 | 470,000 | 710,000 | 850,000 | 1,100,000 | 1,400,000 | 1,400,000 | 2,100,000 | 2,100,000 |
| | Dense | | | 10,000 | 15,000 | 24,000 | 43,000 | 64,000 | 87,000 | 110,000 | 130,000 | 190,000 | 240,000 | 280,000 |
| | Vineyard | | | 53,000 | 100,000 | 190,000 | 360,000 | 530,000 | 710,000 | 850,000 | 1,100,000 | 1,400,000 | 2,100,000 | 2,100,000 |

**Table E.2. Children (1<2 years old) Risk Estimates (MOEs) Related to Indirect Exposure to Spray Drift for Malathion for the Combined Dermal and Oral Routes of Exposure**

| Crop/Rate Group | Spray Type/ Nozzle Configuration | Appl. Rate (lb ai/A) | TTR (ug/cm 2) | At Edge | 10 Feet | 25 Feet | 50 Feet | 75 Feet | 100 Feet | 125 Feet | 150 Feet | 200 Feet | 250 Feet | 300 Feet |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Fencerows and Hedgerows | | | | | | | | | | | | | | |
| | ***Fine to Medium*** | | | 14 | 17 | 22 | 28 | 37 | 48 | 58 | 68 | 89 | 110 | 130 |
| | Medium to Coarse | | | 17 | 23 | 32 | 44 | 63 | 83 | 100 | 130 | 170 | 230 | 280 |
| | Coarse to Very Coarse | | | 20 | 29 | 44 | 69 | 99 | 130 | 170 | 200 | 280 | 360 | 460 |
| | Very Fine to Fine | | | 10 | 11 | 12 | 14 | 16 | 19 | 21 | 24 | 29 | 34 | 38 |
| Aerial | AT401, M, 10 mph, 37% SD | | | 16 | 20 | 26 | 35 | 47 | 61 | 74 | 87 | 110 | 140 | 170 |
| | WASP, M, 10 mph, 37% SD | | | 17 | 21 | 28 | 42 | 58 | 74 | 91 | 110 | 140 | 170 | 200 |
| | AT401, C, 10 mph, 25% SD | | | 18 | 26 | 37 | 54 | 78 | 100 | 130 | 150 | 210 | 280 | 330 |
| | WASP, C, 10 mph, 25% SD | | | 21 | 30 | 43 | 69 | 96 | 130 | 160 | 200 | 280 | 360 | 410 |
| | AT401, VC, 10 mph, 20% SD | | | 21 | 32 | 51 | 83 | 120 | 160 | 200 | 260 | 360 | 460 | 610 |
| | WASP, VC, 10 mph, 20% SD | 10.6 | 2.8 | 26 | 41 | 64 | 100 | 150 | 190 | 260 | 300 | 460 | 520 | 610 |
| | ***High Boom Very fine to Fine*** | | | 20 | 39 | 65 | 100 | 150 | 180 | 210 | 260 | 330 | 460 | 520 |
| Groundboom | Low Boom Very fine to Fine | | | 43 | 110 | 180 | 280 | 360 | 460 | 520 | 610 | 730 | 910 | 1,200 |
| | High Boom Fine to Medium/Coarse | | | 74 | 190 | 280 | 410 | 520 | 610 | 730 | 730 | 910 | 1,200 | 1,200 |
| | Low Boom Fine to Medium/Coarse | | | 110 | 300 | 460 | 610 | 730 | 910 | 1,200 | 1,200 | 1,800 | 1,800 | 1,800 |
| | ***Sparse*** | | | 25 | 44 | 82 | 180 | 330 | 540 | 810 | 1,100 | 2,000 | 3,300 | 4,600 |
| Airblast | Normal | | | 1,200 | 1,800 | 2,800 | 4,100 | 6,100 | 7,300 | 9,100 | 12,000 | 12,000 | 18,000 | 18,000 |
| | Dense | | | 86 | 130 | 210 | 360 | 540 | 740 | 940 | 1,100 | 1,600 | 2,000 | 2,400 |
| | Vineyard | | | 460 | 890 | 1,700 | 3,000 | 4,600 | 6,100 | 7,300 | 9,100 | 12,000 | 18,000 | 18,000 |
| Citrus (CA) | | | | | | | | | | | | | | |
| Aerial | ***Fine to Medium*** | 7.5 | 2.0 | 20 | 25 | 31 | 40 | 53 | 68 | 82 | 95 | 130 | 150 | 180 |

**Table E.2. Children (1<2 years old) Risk Estimates (MOEs) Related to Indirect Exposure to Spray Drift for Malathion for the Combined Dermal and Oral Routes of Exposure**

| Crop/Rate Group | Spray Type/ Nozzle Configuration | Appl. Rate (lb ai/A) | TTR (ug/cm 2) | At Edge | 10 Feet | 25 Feet | 50 Feet | 75 Feet | 100 Feet | 125 Feet | 150 Feet | 200 Feet | 250 Feet | 300 Feet |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Groundboom | Medium to Coarse | | | 24 | 33 | 45 | 63 | 89 | 120 | 150 | 180 | 250 | 320 | 400 |
| | Coarse to Very Coarse | | | 28 | 42 | 63 | 97 | 140 | 180 | 230 | 290 | 400 | 520 | 640 |
| | Very Fine to Fine | | | 14 | 15 | 17 | 20 | 23 | 26 | 29 | 33 | 41 | 48 | 54 |
| | AT401, M, 10 mph, 37% SD | | | 22 | 28 | 36 | 49 | 66 | 86 | 110 | 120 | 160 | 200 | 250 |
| | WASP, M, 10 mph, 37% SD | | | 24 | 30 | 40 | 60 | 82 | 110 | 130 | 150 | 200 | 250 | 290 |
| | AT401, C, 10 mph, 25% SD | | | 26 | 37 | 52 | 77 | 110 | 140 | 180 | 210 | 300 | 400 | 470 |
| | WASP, C, 10 mph, 25% SD | | | 30 | 43 | 61 | 97 | 140 | 180 | 220 | 290 | 400 | 520 | 570 |
| | AT401, VC, 10 mph, 20% SD | | | 29 | 45 | 72 | 120 | 170 | 220 | 290 | 370 | 520 | 640 | 860 |
| | WASP, VC, 10 mph, 20% SD | | | 37 | 59 | 90 | 140 | 210 | 270 | 370 | 430 | 640 | 740 | 860 |
| | ***High Boom Very fine to Fine*** | | | 28 | 55 | 92 | 150 | 210 | 260 | 300 | 370 | 470 | 640 | 740 |
| | Low Boom Very fine to Fine | | | 61 | 160 | 260 | 400 | 520 | 640 | 740 | 860 | 1,000 | 1,300 | 1,700 |
| | High Boom Fine to Medium/Coarse | | | 110 | 270 | 400 | 570 | 740 | 860 | 1,000 | 1,000 | 1,300 | 1,700 | 1,700 |
| | Low Boom Fine to Medium/Coarse | | | 160 | 430 | 640 | 860 | 1,000 | 1,300 | 1,700 | 1,700 | 2,600 | 2,600 | 2,600 |
| Airblast | ***Sparse*** | | | 36 | 62 | 120 | 260 | 470 | 760 | 1,100 | 1,600 | 2,900 | 4,700 | 6,400 |
| | Normal | | | 1,700 | 2,600 | 4,000 | 5,700 | 8,600 | 10,000 | 13,000 | 17,000 | 17,000 | 26,000 | 26,000 |
| | Dense | | | 120 | 180 | 290 | 520 | 770 | 1,100 | 1,300 | 1,600 | 2,200 | 2,900 | 3,400 |
| | Vineyard | | | 640 | 1,300 | 2,300 | 4,300 | 6,400 | 8,600 | 10,000 | 13,000 | 17,000 | 26,000 | 26,000 |
| Kumquats, Citrus (including FL, except lemon in FL) | | | | | | | | | | | | | | |
| Aerial | ***Fine to Medium*** | 4.5 | 1.2 | 33 | 41 | 51 | 67 | 88 | 110 | 140 | 160 | 210 | 250 | 310 |
| | Medium to Coarse | | | 41 | 55 | 75 | 100 | 150 | 200 | 250 | 300 | 410 | 540 | 660 |
| | Coarse to Very Coarse | | | 47 | 69 | 100 | 160 | 230 | 310 | 390 | 480 | 660 | 860 | 1,100 |

**Table E.2. Children (1<2 years old) Risk Estimates (MOEs) Related to Indirect Exposure to Spray Drift for Malathion for the Combined Dermal and Oral Routes of Exposure**

| Crop/Rate Group | Spray Type/ Nozzle Configuration | Appl. Rate (lb ai/A) | TTR (ug/cm 2) | At Edge | 10 Feet | 25 Feet | 50 Feet | 75 Feet | 100 Feet | 125 Feet | 150 Feet | 200 Feet | 250 Feet | 300 Feet |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Groundboom | Very Fine to Fine | 3 | 0.80 | 23 | 25 | 28 | 33 | 38 | 44 | 49 | 55 | 68 | 80 | 90 |
| | AT401, M, 10 mph, 37% SD | | | 37 | 47 | 61 | 82 | 110 | 140 | 180 | 200 | 270 | 330 | 410 |
| | WASP, M, 10 mph, 37% SD | | | 39 | 50 | 67 | 100 | 140 | 180 | 210 | 250 | 330 | 410 | 480 |
| | AT401, C, 10 mph, 25% SD | | | 43 | 61 | 87 | 130 | 180 | 240 | 300 | 360 | 510 | 660 | 780 |
| | WASP, C, 10 mph, 25% SD | | | 50 | 71 | 100 | 160 | 230 | 310 | 370 | 480 | 660 | 860 | 950 |
| | AT401, VC, 10 mph, 20% SD | | | 49 | 75 | 120 | 200 | 280 | 370 | 480 | 610 | 860 | 1,100 | 1,400 |
| | WASP, VC, 10 mph, 20% SD | | | 62 | 98 | 150 | 240 | 340 | 450 | 610 | 720 | 1,100 | 1,200 | 1,400 |
| | ***High Boom Very fine to Fine*** | | | 46 | 92 | 150 | 250 | 340 | 430 | 510 | 610 | 780 | 1,100 | 1,200 |
| | Low Boom Very fine to Fine | | | 100 | 270 | 430 | 660 | 860 | 1,100 | 1,200 | 1,400 | 1,700 | 2,100 | 2,900 |
| | High Boom Fine to Medium/Coarse | | | 180 | 450 | 660 | 950 | 1,200 | 1,400 | 1,700 | 1,700 | 2,100 | 2,900 | 2,900 |
| | Low Boom Fine to Medium/Coarse | | | 260 | 720 | 1,100 | 1,400 | 1,700 | 2,100 | 2,900 | 2,900 | 4,300 | 4,300 | 4,300 |
| Airblast | ***Sparse*** | | | 60 | 100 | 190 | 430 | 780 | 1,300 | 1,900 | 2,700 | 4,800 | 7,800 | 11,000 |
| | Normal | | | 2,900 | 4,300 | 6,600 | 9,500 | 14,000 | 17,000 | 21,000 | 29,000 | 29,000 | 43,000 | 43,000 |
| | Dense | | | 200 | 310 | 490 | 860 | 1,300 | 1,800 | 2,200 | 2,700 | 3,700 | 4,800 | 5,700 |
| Nectarines, Peaches | Vineyard | | | 1,100 | 2,100 | 3,900 | 7,200 | 11,000 | 14,000 | 17,000 | 21,000 | 29,000 | 43,000 | 43,000 |
| Aerial | ***Fine to Medium*** | | | 50 | 62 | 76 | 100 | 130 | 170 | 200 | 240 | 310 | 380 | 460 |
| | Medium to Coarse | | | 61 | 83 | 110 | 160 | 220 | 290 | 370 | 440 | 610 | 810 | 990 |
| | Coarse to Very Coarse | | | 70 | 100 | 160 | 240 | 350 | 460 | 590 | 720 | 990 | 1,300 | 1,600 |
| | Very Fine to Fine | | | 35 | 38 | 42 | 49 | 57 | 65 | 74 | 83 | 100 | 120 | 140 |
| | AT401, M, 10 mph, 37% SD | | | 55 | 70 | 91 | 120 | 170 | 210 | 260 | 310 | 400 | 500 | 610 |

**Table E.2. Children (1<2 years old) Risk Estimates (MOEs) Related to Indirect Exposure to Spray Drift for Malathion for the Combined Dermal and Oral Routes of Exposure**

| Crop/Rate Group | Spray Type/ Nozzle Configuration | Appl. Rate (lb ai/A) | TTR (ug/cm 2) | At Edge | 10 Feet | 25 Feet | 50 Feet | 75 Feet | 100 Feet | 125 Feet | 150 Feet | 200 Feet | 250 Feet | 300 Feet |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | WASP, M, 10 mph, 37% SD | | | 59 | 75 | 100 | 150 | 200 | 260 | 320 | 380 | 500 | 610 | 720 |
| | AT401, C, 10 mph, 25% SD | | | 65 | 91 | 130 | 190 | 270 | 360 | 440 | 540 | 760 | 990 | 1,200 |
| | WASP, C, 10 mph, 25% SD | | | 75 | 110 | 150 | 240 | 340 | 460 | 560 | 720 | 990 | 1,300 | 1,400 |
| | AT401, VC, 10 mph, 20% SD | | | 74 | 110 | 180 | 290 | 420 | 560 | 720 | 920 | 1,300 | 1,600 | 2,100 |
| | WASP, VC, 10 mph, 20% SD | | | 93 | 150 | 230 | 360 | 520 | 680 | 920 | 1,100 | 1,600 | 1,800 | 2,100 |
| | ***High Boom Very fine to Fine*** | | | 69 | 140 | 230 | 370 | 520 | 640 | 760 | 920 | 1,200 | 1,600 | 1,800 |
| Groundboom | Low Boom Very fine to Fine | | | 150 | 400 | 640 | 990 | 1,300 | 1,600 | 1,800 | 2,100 | 2,600 | 3,200 | 4,300 |
| | High Boom Fine to Medium/Coarse | | | 260 | 680 | 990 | 1,400 | 1,800 | 2,100 | 2,600 | 2,600 | 3,200 | 4,300 | 4,300 |
| | Low Boom Fine to Medium/Coarse | | | 390 | 1,100 | 1,600 | 2,100 | 2,600 | 3,200 | 4,300 | 4,300 | 6,400 | 6,400 | 6,400 |
| | ***Sparse*** | | | 90 | 150 | 290 | 640 | 1,200 | 1,900 | 2,900 | 4,000 | 7,200 | 12,000 | 16,000 |
| Airblast | Normal | | | 4,300 | 6,400 | 9,900 | 14,000 | 21,000 | 26,000 | 32,000 | 43,000 | 43,000 | 64,000 | 64,000 |
| | Dense | | | 310 | 460 | 740 | 1,300 | 1,900 | 2,600 | 3,300 | 4,000 | 5,600 | 7,200 | 8,600 |
| | Vineyard | | | 1,600 | 3,100 | 5,900 | 11,000 | 16,000 | 21,000 | 26,000 | 32,000 | 43,000 | 64,000 | 64,000 |
| Chestnut, Cotton, Pecans, Walnut | | | | | | | | | | | | | | |
| | ***Fine to Medium*** | | | 60 | 74 | 92 | 120 | 160 | 200 | 250 | 290 | 380 | 450 | 550 |
| | Medium to Coarse | | | 73 | 99 | 130 | 190 | 270 | 350 | 440 | 530 | 740 | 970 | 1,200 |
| | Coarse to Very Coarse | | | 85 | 120 | 190 | 290 | 420 | 550 | 700 | 860 | 1,200 | 1,500 | 1,900 |
| Aerial | Very Fine to Fine | 2.5 | 0.66 | 41 | 45 | 51 | 59 | 68 | 79 | 88 | 100 | 120 | 140 | 160 |
| | AT401, M, 10 mph, 37% SD | | | 66 | 85 | 110 | 150 | 200 | 260 | 320 | 370 | 480 | 590 | 740 |
| | WASP, M, 10 mph, 37% SD | | | 71 | 90 | 120 | 180 | 250 | 320 | 390 | 450 | 590 | 740 | 860 |
| | AT401, C, 10 mph, 25% SD | | | 78 | 110 | 160 | 230 | 330 | 430 | 530 | 640 | 910 | 1,200 | 1,400 |

**Table E.2. Children (1<2 years old) Risk Estimates (MOEs) Related to Indirect Exposure to Spray Drift for Malathion for the Combined Dermal and Oral Routes of Exposure**

| Crop/Rate Group | Spray Type/ Nozzle Configuration | Appl. Rate (lb ai/A) | TTR (ug/cm 2) | At Edge | 10 Feet | 25 Feet | 50 Feet | 75 Feet | 100 Feet | 125 Feet | 150 Feet | 200 Feet | 250 Feet | 300 Feet |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Groundboom | WASP, C, 10 mph, 25% SD | 2.23 | 0.59 | 90 | 130 | 180 | 290 | 410 | 550 | 670 | 860 | 1,200 | 1,500 | 1,700 |
| | AT401, VC, 10 mph, 20% SD | | | 88 | 130 | 210 | 350 | 500 | 670 | 860 | 1,100 | 1,500 | 1,900 | 2,600 |
| | WASP, VC, 10 mph, 20% SD | | | 110 | 180 | 270 | 430 | 620 | 810 | 1,100 | 1,300 | 1,900 | 2,200 | 2,600 |
| | ***High Boom Very fine to Fine*** | | | 83 | 170 | 280 | 440 | 620 | 770 | 910 | 1,100 | 1,400 | 1,900 | 2,200 |
| | Low Boom Very fine to Fine | | | 180 | 480 | 770 | 1,200 | 1,500 | 1,900 | 2,200 | 2,600 | 3,100 | 3,900 | 5,200 |
| | High Boom Fine to Medium/Coarse | | | 320 | 810 | 1,200 | 1,700 | 2,200 | 2,600 | 3,100 | 3,100 | 3,900 | 5,200 | 5,200 |
| | Low Boom Fine to Medium/Coarse | | | 470 | 1,300 | 1,900 | 2,600 | 3,100 | 3,900 | 5,200 | 5,200 | 7,700 | 7,700 | 7,700 |
| Airblast | ***Sparse*** | | | 110 | 190 | 350 | 770 | 1,400 | 2,300 | 3,400 | 4,800 | 8,600 | 14,000 | 19,000 |
| | Normal | | | 5,200 | 7,700 | 12,000 | 17,000 | 26,000 | 31,000 | 39,000 | 52,000 | 52,000 | 77,000 | 77,000 |
| | Dense | | | 370 | 550 | 880 | 1,500 | 2,300 | 3,200 | 4,000 | 4,800 | 6,700 | 8,600 | 10,000 |
| Apples | Vineyard | | | 1,900 | 3,800 | 7,000 | 13,000 | 19,000 | 26,000 | 31,000 | 39,000 | 52,000 | 77,000 | 77,000 |
| Aerial | ***Fine to Medium*** | | | 67 | 83 | 100 | 130 | 180 | 230 | 280 | 320 | 420 | 510 | 620 |
| | Medium to Coarse | | | 82 | 110 | 150 | 210 | 300 | 390 | 500 | 600 | 830 | 1,100 | 1,300 |
| | Coarse to Very Coarse | | | 95 | 140 | 210 | 330 | 470 | 620 | 790 | 960 | 1,300 | 1,700 | 2,200 |
| | Very Fine to Fine | | | 46 | 51 | 57 | 66 | 77 | 88 | 99 | 110 | 140 | 160 | 180 |
| | AT401, M, 10 mph, 37% SD | | | 74 | 95 | 120 | 170 | 220 | 290 | 350 | 410 | 540 | 670 | 830 |
| | WASP, M, 10 mph, 37% SD | | | 80 | 100 | 130 | 200 | 280 | 350 | 430 | 510 | 670 | 830 | 960 |
| | AT401, C, 10 mph, 25% SD | | | 88 | 120 | 180 | 260 | 370 | 480 | 600 | 720 | 1,000 | 1,300 | 1,600 |
| | WASP, C, 10 mph, 25% SD | | | 100 | 140 | 210 | 330 | 460 | 620 | 750 | 960 | 1,300 | 1,700 | 1,900 |
| | AT401, VC, 10 mph, 20% SD | | | 99 | 150 | 240 | 390 | 560 | 750 | 960 | 1,200 | 1,700 | 2,200 | 2,900 |

**Table E.2. Children (1<2 years old) Risk Estimates (MOEs) Related to Indirect Exposure to Spray Drift for Malathion for the Combined Dermal and Oral Routes of Exposure**

| Crop/Rate Group | Spray Type/ Nozzle Configuration | Appl. Rate (lb ai/A) | TTR (ug/cm 2) | At Edge | 10 Feet | 25 Feet | 50 Feet | 75 Feet | 100 Feet | 125 Feet | 150 Feet | 200 Feet | 250 Feet | 300 Feet |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | WASP, VC, 10 mph, 20% SD | | | 130 | 200 | 300 | 480 | 690 | 910 | 1,200 | 1,400 | 2,200 | 2,500 | 2,900 |
| | ***High Boom Very fine to Fine*** | | | 93 | 190 | 310 | 500 | 690 | 870 | 1,000 | 1,200 | 1,600 | 2,200 | 2,500 |
| Groundboom | Low Boom Very fine to Fine | | | 200 | 540 | 870 | 1,300 | 1,700 | 2,200 | 2,500 | 2,900 | 3,500 | 4,300 | 5,800 |
| | High Boom Fine to Medium/Coarse | | | 350 | 910 | 1,300 | 1,900 | 2,500 | 2,900 | 3,500 | 3,500 | 4,300 | 5,800 | 5,800 |
| | Low Boom Fine to Medium/Coarse | | | 530 | 1,400 | 2,200 | 2,900 | 3,500 | 4,300 | 5,800 | 5,800 | 8,700 | 8,700 | 8,700 |
| | ***Sparse*** | | | 120 | 210 | 390 | 870 | 1,600 | 2,600 | 3,900 | 5,400 | 9,600 | 16,000 | 22,000 |
| Airblast | Normal | | | 5,800 | 8,700 | 13,000 | 19,000 | 29,000 | 35,000 | 43,000 | 58,000 | 58,000 | 87,000 | 87,000 |
| | Dense | | | 410 | 620 | 990 | 1,700 | 2,600 | 3,500 | 4,400 | 5,400 | 7,500 | 9,600 | 12,000 |
| | Vineyard | | | 2,200 | 4,200 | 7,900 | 14,000 | 22,000 | 29,000 | 35,000 | 43,000 | 58,000 | 87,000 | 87,000 |
| Arugula, Amaranth, Caneberries, Chervil, Chrysanthenmum, Corn salad, Dock(sorrel), Figs, Orach, Ornamentals, Purslane, Strawberries, Celtuce, Florence fennel, Gooseberry, Pineapple | | | | | | | | | | | | | | |
| | ***Fine to Medium*** | | | 75 | 93 | 110 | 150 | 200 | 250 | 310 | 360 | 470 | 570 | 690 |
| | Medium to Coarse | | | 92 | 120 | 170 | 240 | 330 | 440 | 550 | 670 | 920 | 1,200 | 1,500 |
| | Coarse to Very Coarse | | | 110 | 160 | 240 | 360 | 520 | 690 | 880 | 1,100 | 1,500 | 1,900 | 2,400 |
| | Very Fine to Fine | | | 52 | 57 | 63 | 74 | 86 | 98 | 110 | 120 | 150 | 180 | 200 |
| | AT401, M, 10 mph, 37% SD | | | 83 | 110 | 140 | 180 | 250 | 320 | 390 | 460 | 600 | 740 | 920 |
| Aerial | WASP, M, 10 mph, 37% SD | 2 | 0.53 | 89 | 110 | 150 | 220 | 310 | 390 | 480 | 570 | 740 | 920 | 1,100 |
| | AT401, C, 10 mph, 25% SD | | | 98 | 140 | 200 | 290 | 410 | 540 | 670 | 810 | 1,100 | 1,500 | 1,800 |
| | WASP, C, 10 mph, 25% SD | | | 110 | 160 | 230 | 360 | 510 | 690 | 840 | 1,100 | 1,500 | 1,900 | 2,100 |
| | AT401, VC, 10 mph, 20% SD | | | 110 | 170 | 270 | 440 | 620 | 840 | 1,100 | 1,400 | 1,900 | 2,400 | 3,200 |
| | WASP, VC, 10 mph, 20% SD | | | 140 | 220 | 340 | 540 | 770 | 1,000 | 1,400 | 1,600 | 2,400 | 2,800 | 3,200 |
| Groundboom | ***High Boom Very fine to Fine*** | | | 100 | 210 | 350 | 550 | 770 | 970 | 1,100 | 1,400 | 1,800 | 2,400 | 2,800 |

**Table E.2. Children (1<2 years old) Risk Estimates (MOEs) Related to Indirect Exposure to Spray Drift for Malathion for the Combined Dermal and Oral Routes of Exposure**

| Crop/Rate Group | Spray Type/ Nozzle Configuration | Appl. Rate (lb ai/A) | TTR (ug/cm 2) | At Edge | 10 Feet | 25 Feet | 50 Feet | 75 Feet | 100 Feet | 125 Feet | 150 Feet | 200 Feet | 250 Feet | 300 Feet |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Airblast | Low Boom Very fine to Fine | 1.75 | 0.47 | 230 | 600 | 970 | 1,500 | 1,900 | 2,400 | 2,800 | 3,200 | 3,900 | 4,800 | 6,400 |
| | High Boom Fine to Medium/Coarse | | | 390 | 1,000 | 1,500 | 2,100 | 2,800 | 3,200 | 3,900 | 3,900 | 4,800 | 6,400 | 6,400 |
| | Low Boom Fine to Medium/Coarse | | | 590 | 1,600 | 2,400 | 3,200 | 3,900 | 4,800 | 6,400 | 6,400 | 9,700 | 9,700 | 9,700 |
| | ***Sparse*** | | | 130 | 230 | 440 | 970 | 1,800 | 2,800 | 4,300 | 6,000 | 11,000 | 18,000 | 24,000 |
| | Normal | | | 6,400 | 9,700 | 15,000 | 21,000 | 32,000 | 39,000 | 48,000 | 64,000 | 64,000 | 97,000 | 97,000 |
| | Dense | | | 460 | 690 | 1,100 | 1,900 | 2,900 | 3,900 | 5,000 | 6,000 | 8,400 | 11,000 | 13,000 |
| | Vineyard | | | 2,400 | 4,700 | 8,800 | 16,000 | 24,000 | 32,000 | 39,000 | 48,000 | 64,000 | 97,000 | 97,000 |
| Chayote fruit, Cherries, Cucumber, Summer squash | | | | | | | | | | | | | | |
| Aerial | ***Fine to Medium*** | | | 86 | 110 | 130 | 170 | 230 | 290 | 350 | 410 | 540 | 650 | 790 |
| | Medium to Coarse | | | 100 | 140 | 190 | 270 | 380 | 500 | 630 | 760 | 1,100 | 1,400 | 1,700 |
| | Coarse to Very Coarse | | | 120 | 180 | 270 | 420 | 600 | 790 | 1,000 | 1,200 | 1,700 | 2,200 | 2,800 |
| | Very Fine to Fine | | | 59 | 65 | 72 | 84 | 98 | 110 | 130 | 140 | 170 | 200 | 230 |
| | AT401, M, 10 mph, 37% SD | | | 94 | 120 | 160 | 210 | 280 | 370 | 450 | 530 | 690 | 850 | 1,100 |
| | WASP, M, 10 mph, 37% SD | | | 100 | 130 | 170 | 260 | 350 | 450 | 550 | 650 | 850 | 1,100 | 1,200 |
| | AT401, C, 10 mph, 25% SD | | | 110 | 160 | 220 | 330 | 470 | 610 | 760 | 920 | 1,300 | 1,700 | 2,000 |
| | WASP, C, 10 mph, 25% SD | | | 130 | 180 | 260 | 420 | 580 | 790 | 960 | 1,200 | 1,700 | 2,200 | 2,500 |
| | AT401, VC, 10 mph, 20% SD | | | 130 | 190 | 310 | 500 | 710 | 960 | 1,200 | 1,600 | 2,200 | 2,800 | 3,700 |
| | WASP, VC, 10 mph, 20% SD | | | 160 | 250 | 390 | 610 | 880 | 1,200 | 1,600 | 1,800 | 2,800 | 3,200 | 3,700 |
| Groundboom | ***High Boom Very fine to Fine*** | | | 120 | 240 | 390 | 630 | 880 | 1,100 | 1,300 | 1,600 | 2,000 | 2,800 | 3,200 |
| | Low Boom Very fine to Fine | | | 260 | 690 | 1,100 | 1,700 | 2,200 | 2,800 | 3,200 | 3,700 | 4,400 | 5,500 | 7,400 |
| | High Boom Fine to Medium/Coarse | | | 450 | 1,200 | 1,700 | 2,500 | 3,200 | 3,700 | 4,400 | 4,400 | 5,500 | 7,400 | 7,400 |

**Table E.2. Children (1<2 years old) Risk Estimates (MOEs) Related to Indirect Exposure to Spray Drift for Malathion for the Combined Dermal and Oral Routes of Exposure**

| Crop/Rate Group | Spray Type/ Nozzle Configuration | Appl. Rate (lb ai/A) | TTR (ug/cm 2) | At Edge | 10 Feet | 25 Feet | 50 Feet | 75 Feet | 100 Feet | 125 Feet | 150 Feet | 200 Feet | 250 Feet | 300 Feet |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Airblast | Low Boom Fine to Medium/Coarse | | | 670 | 1,800 | 2,800 | 3,700 | 4,400 | 5,500 | 7,400 | 7,400 | 11,000 | 11,000 | 11,000 |
| | ***Sparse*** | | | 150 | 260 | 500 | 1,100 | 2,000 | 3,200 | 4,900 | 6,900 | 12,000 | 20,000 | 28,000 |
| | Normal | | | 7,400 | 11,000 | 17,000 | 25,000 | 37,000 | 44,000 | 55,000 | 74,000 | 74,000 | 110,000 | 110,000 |
| | Dense | | | 520 | 790 | 1,300 | 2,200 | 3,300 | 4,500 | 5,700 | 6,900 | 9,600 | 12,000 | 15,000 |
| | Vineyard | | | 2,800 | 5,400 | 10,000 | 18,000 | 28,000 | 37,000 | 44,000 | 55,000 | 74,000 | 110,000 | 110,000 |
| Chayote root, Eggplant, Garlic, Leeks, Onions, Peppers, Bell Peppers, Potatoes, Shallots, Sweet potatoes, Tomatoes, Yams | | | | | | | | | | | | | | |
| Aerial | ***Fine to Medium*** | 1.56 | 0.41 | 96 | 120 | 150 | 190 | 250 | 330 | 390 | 460 | 600 | 730 | 890 |
| | Medium to Coarse | | | 120 | 160 | 220 | 300 | 430 | 560 | 710 | 850 | 1,200 | 1,500 | 1,900 |
| | Coarse to Very Coarse | | | 140 | 200 | 300 | 470 | 670 | 890 | 1,100 | 1,400 | 1,900 | 2,500 | 3,100 |
| | Very Fine to Fine | | | 66 | 73 | 81 | 95 | 110 | 130 | 140 | 160 | 200 | 230 | 260 |
| | AT401, M, 10 mph, 37% SD | | | 110 | 140 | 170 | 240 | 320 | 410 | 510 | 590 | 770 | 950 | 1,200 |
| | WASP, M, 10 mph, 37% SD | | | 110 | 140 | 190 | 290 | 390 | 510 | 620 | 730 | 950 | 1,200 | 1,400 |
| | AT401, C, 10 mph, 25% SD | | | 130 | 180 | 250 | 370 | 530 | 690 | 850 | 1,000 | 1,500 | 1,900 | 2,300 |
| | WASP, C, 10 mph, 25% SD | | | 140 | 200 | 300 | 470 | 650 | 890 | 1,100 | 1,400 | 1,900 | 2,500 | 2,800 |
| | AT401, VC, 10 mph, 20% SD | | | 140 | 220 | 340 | 560 | 800 | 1,100 | 1,400 | 1,800 | 2,500 | 3,100 | 4,100 |
| | WASP, VC, 10 mph, 20% SD | | | 180 | 280 | 430 | 690 | 990 | 1,300 | 1,800 | 2,100 | 3,100 | 3,500 | 4,100 |
| Groundboom | ***High Boom Very fine to Fine*** | | | 130 | 270 | 440 | 710 | 990 | 1,200 | 1,500 | 1,800 | 2,300 | 3,100 | 3,500 |
| | Low Boom Very fine to Fine | | | 290 | 770 | 1,200 | 1,900 | 2,500 | 3,100 | 3,500 | 4,100 | 5,000 | 6,200 | 8,300 |
| | High Boom Fine to Medium/Coarse | | | 510 | 1,300 | 1,900 | 2,800 | 3,500 | 4,100 | 5,000 | 5,000 | 6,200 | 8,300 | 8,300 |
| Airblast | Low Boom Fine to Medium/Coarse | | | 750 | 2,100 | 3,100 | 4,100 | 5,000 | 6,200 | 8,300 | 8,300 | 12,000 | 12,000 | 12,000 |
| | ***Sparse*** | | | 170 | 300 | 560 | 1,200 | 2,300 | 3,600 | 5,500 | 7,700 | 14,000 | 23,000 | 31,000 |

**Table E.2. Children (1<2 years old) Risk Estimates (MOEs) Related to Indirect Exposure to Spray Drift for Malathion for the Combined Dermal and Oral Routes of Exposure**

| Crop/Rate Group | Spray Type/ Nozzle Configuration | Appl. Rate (lb ai/A) | TTR (ug/cm 2) | At Edge | 10 Feet | 25 Feet | 50 Feet | 75 Feet | 100 Feet | 125 Feet | 150 Feet | 200 Feet | 250 Feet | 300 Feet |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Apricot, Beans, Celery, Lentils, Parsley, Tangerines, Watermelon, | Normal | 1.5 | 0.40 | 8,300 | 12,000 | 19,000 | 28,000 | 41,000 | 50,000 | 62,000 | 83,000 | 83,000 | 120,000 | 120,000 |
| | Dense | | | 590 | 890 | 1,400 | 2,500 | 3,700 | 5,100 | 6,400 | 7,700 | 11,000 | 14,000 | 17,000 |
| | Vineyard | | | 3,100 | 6,000 | 11,000 | 21,000 | 31,000 | 41,000 | 50,000 | 62,000 | 83,000 | 120,000 | 120,000 |
| Aerial | ***Fine to Medium*** | | | 100 | 120 | 150 | 200 | 260 | 340 | 410 | 480 | 630 | 760 | 920 |
| | Medium to Coarse | | | 120 | 170 | 220 | 310 | 440 | 590 | 740 | 890 | 1,200 | 1,600 | 2,000 |
| | Coarse to Very Coarse | | | 140 | 210 | 310 | 490 | 700 | 920 | 1,200 | 1,400 | 2,000 | 2,600 | 3,200 |
| | Very Fine to Fine | | | 69 | 76 | 85 | 98 | 110 | 130 | 150 | 170 | 200 | 240 | 270 |
| | AT401, M, 10 mph, 37% SD | | | 110 | 140 | 180 | 250 | 330 | 430 | 530 | 610 | 810 | 990 | 1,200 |
| | WASP, M, 10 mph, 37% SD | | | 120 | 150 | 200 | 300 | 410 | 530 | 640 | 760 | 990 | 1,200 | 1,400 |
| | AT401, C, 10 mph, 25% SD | | | 130 | 180 | 260 | 380 | 550 | 720 | 890 | 1,100 | 1,500 | 2,000 | 2,300 |
| | WASP, C, 10 mph, 25% SD | | | 150 | 210 | 310 | 490 | 680 | 920 | 1,100 | 1,400 | 2,000 | 2,600 | 2,900 |
| | AT401, VC, 10 mph, 20% SD | | | 150 | 220 | 360 | 590 | 830 | 1,100 | 1,400 | 1,800 | 2,600 | 3,200 | 4,300 |
| | WASP, VC, 10 mph, 20% SD | | | 190 | 290 | 450 | 720 | 1,000 | 1,400 | 1,800 | 2,100 | 3,200 | 3,700 | 4,300 |
| Groundboom | ***High Boom Very fine to Fine*** | | | 140 | 280 | 460 | 740 | 1,000 | 1,300 | 1,500 | 1,800 | 2,300 | 3,200 | 3,700 |
| | Low Boom Very fine to Fine | | | 300 | 810 | 1,300 | 2,000 | 2,600 | 3,200 | 3,700 | 4,300 | 5,200 | 6,400 | 8,600 |
| | High Boom Fine to Medium/Coarse | | | 530 | 1,400 | 2,000 | 2,900 | 3,700 | 4,300 | 5,200 | 5,200 | 6,400 | 8,600 | 8,600 |
| | Low Boom Fine to Medium/Coarse | | | 780 | 2,100 | 3,200 | 4,300 | 5,200 | 6,400 | 8,600 | 8,600 | 13,000 | 13,000 | 13,000 |
| Airblast | ***Sparse*** | | | 180 | 310 | 580 | 1,300 | 2,300 | 3,800 | 5,700 | 8,100 | 14,000 | 23,000 | 32,000 |
| | Normal | | | 8,600 | 13,000 | 20,000 | 29,000 | 43,000 | 52,000 | 64,000 | 86,000 | 86,000 | 130,000 | 130,000 |
| | Dense | | | 610 | 920 | 1,500 | 2,600 | 3,800 | 5,300 | 6,600 | 8,100 | 11,000 | 14,000 | 17,000 |

**Table E.2. Children (1<2 years old) Risk Estimates (MOEs) Related to Indirect Exposure to Spray Drift for Malathion for the Combined Dermal and Oral Routes of Exposure**

| Crop/Rate Group | Spray Type/ Nozzle Configuration | Appl. Rate (lb ai/A) | TTR (ug/cm 2) | At Edge | 10 Feet | 25 Feet | 50 Feet | 75 Feet | 100 Feet | 125 Feet | 150 Feet | 200 Feet | 250 Feet | 300 Feet |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Vineyard | | | 3,200 | 6,300 | 12,000 | 21,000 | 32,000 | 43,000 | 52,000 | 64,000 | 86,000 | 130,000 | 130,000 |
| Alfalfa, Asparagus, Barley, Beets, Broccoli, Brussel Sprouts, Cabbage, Carrot, Cauliflower, Chinese greens, Clover, Currant, Dandelion, Endive, Bermuda Grass, Forage and hay grass, Guava, Horseradish, Kohlrabi, Lemons (FL), Lespedeza, Papaya, Parsnip, Pears, Rice, Salsify, Trefoil, Turnips, Vetch, Watercress, Wild Rice | | | | | | | | | | | | | | |
| | ***Fine to Medium*** | | | 120 | 150 | 180 | 240 | 320 | 410 | 490 | 570 | 750 | 910 | 1,100 |
| | Medium to Coarse | | | 150 | 200 | 270 | 380 | 530 | 700 | 880 | 1,100 | 1,500 | 1,900 | 2,400 |
| | Coarse to Very Coarse | | | 170 | 250 | 380 | 580 | 840 | 1,100 | 1,400 | 1,700 | 2,400 | 3,100 | 3,900 |
| | Very Fine to Fine | | | 83 | 91 | 100 | 120 | 140 | 160 | 180 | 200 | 240 | 290 | 330 |
| Aerial | AT401, M, 10 mph, 37% SD | | | 130 | 170 | 220 | 290 | 400 | 520 | 630 | 740 | 970 | 1,200 | 1,500 |
| | WASP, M, 10 mph, 37% SD | | | 140 | 180 | 240 | 360 | 490 | 630 | 770 | 910 | 1,200 | 1,500 | 1,700 |
| | AT401, C, 10 mph, 25% SD | | | 160 | 220 | 310 | 460 | 660 | 860 | 1,100 | 1,300 | 1,800 | 2,400 | 2,800 |
| | WASP, C, 10 mph, 25% SD | | | 180 | 260 | 370 | 580 | 810 | 1,100 | 1,300 | 1,700 | 2,400 | 3,100 | 3,400 |
| | AT401, VC, 10 mph, 20% SD | 1.25 | 0.33 | 180 | 270 | 430 | 700 | 1,000 | 1,300 | 1,700 | 2,200 | 3,100 | 3,900 | 5,200 |
| | WASP, VC, 10 mph, 20% SD | | | 220 | 350 | 540 | 860 | 1,200 | 1,600 | 2,200 | 2,600 | 3,900 | 4,400 | 5,200 |
| | ***High Boom Very fine to Fine*** | | | 170 | 330 | 550 | 880 | 1,200 | 1,500 | 1,800 | 2,200 | 2,800 | 3,900 | 4,400 |
| Groundboom | Low Boom Very fine to Fine | | | 360 | 970 | 1,500 | 2,400 | 3,100 | 3,900 | 4,400 | 5,200 | 6,200 | 7,700 | 10,000 |
| | High Boom Fine to Medium/Coarse | | | 630 | 1,600 | 2,400 | 3,400 | 4,400 | 5,200 | 6,200 | 6,200 | 7,700 | 10,000 | 10,000 |
| | Low Boom Fine to Medium/Coarse | | | 940 | 2,600 | 3,900 | 5,200 | 6,200 | 7,700 | 10,000 | 10,000 | 15,000 | 15,000 | 15,000 |
| | ***Sparse*** | | | 220 | 370 | 700 | 1,500 | 2,800 | 4,500 | 6,900 | 9,700 | 17,000 | 28,000 | 39,000 |
| Airblast | Normal | | | 10,000 | 15,000 | 24,000 | 34,000 | 52,000 | 62,000 | 77,000 | 100,000 | 100,000 | 150,000 | 150,000 |
| | Dense | | | 730 | 1,100 | 1,800 | 3,100 | 4,600 | 6,300 | 7,900 | 9,700 | 13,000 | 17,000 | 21,000 |
| | Vineyard | | | 3,900 | 7,500 | 14,000 | 26,000 | 39,000 | 52,000 | 62,000 | 77,000 | 100,000 | 150,000 | 150,000 |
| Cotton - Boll Weevil Eradication | | | | | | | | | | | | | | |

**Table E.2. Children (1<2 years old) Risk Estimates (MOEs) Related to Indirect Exposure to Spray Drift for Malathion for the Combined Dermal and Oral Routes of Exposure**

| Crop/Rate Group | Spray Type/ Nozzle Configuration | Appl. Rate (lb ai/A) | TTR (ug/cm 2) | At Edge | 10 Feet | 25 Feet | 50 Feet | 75 Feet | 100 Feet | 125 Feet | 150 Feet | 200 Feet | 250 Feet | 300 Feet |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Aerial | Very Fine to Fine | 1.22 | 0.32 | 85 | 93 | 100 | 120 | 140 | 160 | 180 | 200 | 250 | 290 | 330 |
| Chayote root, Eggplant, Garlic, Leeks, Onions, Peppers, Bell Peppers, Potatoes, Shallots, Sweet potatoes, Tomatoes, Yams | | | | | | | | | | | | | | |
| Aerial | ***Fine to Medium*** | 1 | 0.27 | 150 | 190 | 230 | 300 | 390 | 510 | 610 | 720 | 940 | 1,100 | 1,400 |
| | Medium to Coarse | | | 180 | 250 | 340 | 470 | 670 | 880 | 1,100 | 1,300 | 1,800 | 2,400 | 3,000 |
| | Coarse to Very Coarse | | | 210 | 310 | 470 | 730 | 1,000 | 1,400 | 1,800 | 2,100 | 3,000 | 3,900 | 4,800 |
| | Very Fine to Fine | | | 100 | 110 | 130 | 150 | 170 | 200 | 220 | 250 | 300 | 360 | 410 |
| | AT401, M, 10 mph, 37% SD | | | 170 | 210 | 270 | 370 | 500 | 640 | 790 | 920 | 1,200 | 1,500 | 1,800 |
| | WASP, M, 10 mph, 37% SD | | | 180 | 230 | 300 | 450 | 610 | 790 | 970 | 1,100 | 1,500 | 1,800 | 2,100 |
| | AT401, C, 10 mph, 25% SD | | | 200 | 270 | 390 | 580 | 820 | 1,100 | 1,300 | 1,600 | 2,300 | 3,000 | 3,500 |
| | WASP, C, 10 mph, 25% SD | | | 230 | 320 | 460 | 730 | 1,000 | 1,400 | 1,700 | 2,100 | 3,000 | 3,900 | 4,300 |
| | AT401, VC, 10 mph, 20% SD | | | 220 | 340 | 540 | 880 | 1,200 | 1,700 | 2,100 | 2,800 | 3,900 | 4,800 | 6,400 |
| | WASP, VC, 10 mph, 20% SD | | | 280 | 440 | 680 | 1,100 | 1,500 | 2,000 | 2,800 | 3,200 | 4,800 | 5,500 | 6,400 |
| Groundboom | ***High Boom Very fine to Fine*** | | | 210 | 420 | 690 | 1,100 | 1,500 | 1,900 | 2,300 | 2,800 | 3,500 | 4,800 | 5,500 |
| | Low Boom Very fine to Fine | | | 450 | 1,200 | 1,900 | 3,000 | 3,900 | 4,800 | 5,500 | 6,400 | 7,700 | 9,700 | 13,000 |
| | High Boom Fine to Medium/Coarse | | | 790 | 2,000 | 3,000 | 4,300 | 5,500 | 6,400 | 7,700 | 7,700 | 9,700 | 13,000 | 13,000 |
| | Low Boom Fine to Medium/Coarse | | | 1,200 | 3,200 | 4,800 | 6,400 | 7,700 | 9,700 | 13,000 | 13,000 | 19,000 | 19,000 | 19,000 |
| Airblast | ***Sparse*** | | | 270 | 460 | 870 | 1,900 | 3,500 | 5,700 | 8,600 | 12,000 | 21,000 | 35,000 | 48,000 |
| | Normal | | | 13,000 | 19,000 | 30,000 | 43,000 | 64,000 | 77,000 | 97,000 | 130,000 | 130,000 | 190,000 | 190,000 |
| | Dense | | | 920 | 1,400 | 2,200 | 3,900 | 5,800 | 7,900 | 9,900 | 12,000 | 17,000 | 21,000 | 26,000 |
| | Vineyard | | | 4,800 | 9,400 | 18,000 | 32,000 | 48,000 | 64,000 | 77,000 | 97,000 | 130,000 | 190,000 | 190,000 |
| Blueberry (high and low bush) Honeydew | | | | | | | | | | | | | | |

**Table E.2. Children (1<2 years old) Risk Estimates (MOEs) Related to Indirect Exposure to Spray Drift for Malathion for the Combined Dermal and Oral Routes of Exposure**

| Crop/Rate Group | Spray Type/ Nozzle Configuration | Appl. Rate (lb ai/A) | TTR (ug/cm 2) | At Edge | 10 Feet | 25 Feet | 50 Feet | 75 Feet | 100 Feet | 125 Feet | 150 Feet | 200 Feet | 250 Feet | 300 Feet |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Aerial | ***Fine to Medium*** | 0.77 | 0.20 | 200 | 240 | 300 | 390 | 510 | 660 | 800 | 930 | 1,200 | 1,500 | 1,800 |
| | Medium to Coarse | | | 240 | 320 | 440 | 610 | 870 | 1,100 | 1,400 | 1,700 | 2,400 | 3,100 | 3,900 |
| | Coarse to Very Coarse | | | 270 | 410 | 610 | 950 | 1,400 | 1,800 | 2,300 | 2,800 | 3,900 | 5,000 | 6,300 |
| | Very Fine to Fine | | | 130 | 150 | 160 | 190 | 220 | 250 | 290 | 320 | 400 | 470 | 530 |
| | AT401, M, 10 mph, 37% SD | | | 210 | 270 | 350 | 480 | 640 | 840 | 1,000 | 1,200 | 1,600 | 1,900 | 2,400 |
| | WASP, M, 10 mph, 37% SD | | | 230 | 290 | 390 | 580 | 800 | 1,000 | 1,300 | 1,500 | 1,900 | 2,400 | 2,800 |
| | AT401, C, 10 mph, 25% SD | | | 250 | 360 | 510 | 750 | 1,100 | 1,400 | 1,700 | 2,100 | 3,000 | 3,900 | 4,600 |
| | WASP, C, 10 mph, 25% SD | | | 290 | 420 | 600 | 950 | 1,300 | 1,800 | 2,200 | 2,800 | 3,900 | 5,000 | 5,600 |
| | AT401, VC, 10 mph, 20% SD | | | 290 | 440 | 700 | 1,100 | 1,600 | 2,200 | 2,800 | 3,600 | 5,000 | 6,300 | 8,400 |
| | WASP, VC, 10 mph, 20% SD | | | 360 | 570 | 880 | 1,400 | 2,000 | 2,600 | 3,600 | 4,200 | 6,300 | 7,200 | 8,400 |
| Groundboom | ***High Boom Very fine to Fine*** | | | 270 | 540 | 900 | 1,400 | 2,000 | 2,500 | 3,000 | 3,600 | 4,600 | 6,300 | 7,200 |
| | Low Boom Very fine to Fine | | | 590 | 1,600 | 2,500 | 3,900 | 5,000 | 6,300 | 7,200 | 8,400 | 10,000 | 13,000 | 17,000 |
| | High Boom Fine to Medium/Coarse | | | 1,000 | 2,600 | 3,900 | 5,600 | 7,200 | 8,400 | 10,000 | 10,000 | 13,000 | 17,000 | 17,000 |
| | Low Boom Fine to Medium/Coarse | | | 1,500 | 4,200 | 6,300 | 8,400 | 10,000 | 13,000 | 17,000 | 17,000 | 25,000 | 25,000 | 25,000 |
| Airblast | ***Sparse*** | | | 350 | 600 | 1,100 | 2,500 | 4,600 | 7,400 | 11,000 | 16,000 | 28,000 | 46,000 | 63,000 |
| | Normal | | | 17,000 | 25,000 | 39,000 | 56,000 | 84,000 | 100,000 | 130,000 | 170,000 | 170,000 | 250,000 | 250,000 |
| | Dense | | | 1,200 | 1,800 | 2,900 | 5,000 | 7,500 | 10,000 | 13,000 | 16,000 | 22,000 | 28,000 | 33,000 |
| | Vineyard | | | 6,300 | 12,000 | 23,000 | 42,000 | 63,000 | 84,000 | 100,000 | 130,000 | 170,000 | 250,000 | 250,000 |
| Barley, Beans, Corn, Hops, Lespedeza, Lupine, Oats, Rice, Rye, Sorghum, Wheat, Citrus, USDA-APHIS Rangeland Grasshopper and Mormon Cricket Suppression Program | | | | | | | | | | | | | | |
| Aerial | ***Fine to Medium*** | 0.61 | 0.16 | 250 | 300 | 380 | 490 | 650 | 830 | 1,000 | 1,200 | 1,500 | 1,900 | 2,300 |
| | Medium to Coarse | | | 300 | 410 | 550 | 770 | 1,100 | 1,400 | 1,800 | 2,200 | 3,000 | 4,000 | 4,900 |

**Table E.2. Children (1<2 years old) Risk Estimates (MOEs) Related to Indirect Exposure to Spray Drift for Malathion for the Combined Dermal and Oral Routes of Exposure**

| Crop/Rate Group | Spray Type/ Nozzle Configuration | Appl. Rate (lb ai/A) | TTR (ug/cm 2) | At Edge | 10 Feet | 25 Feet | 50 Feet | 75 Feet | 100 Feet | 125 Feet | 150 Feet | 200 Feet | 250 Feet | 300 Feet |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Groundboom | Coarse to Very Coarse | 0.5 | 0.13 | 350 | 510 | 770 | 1,200 | 1,700 | 2,300 | 2,900 | 3,500 | 4,900 | 6,300 | 7,900 |
| | Very Fine to Fine | | | 170 | 190 | 210 | 240 | 280 | 320 | 360 | 410 | 500 | 590 | 670 |
| | AT401, M, 10 mph, 37% SD | | | 270 | 350 | 450 | 600 | 810 | 1,100 | 1,300 | 1,500 | 2,000 | 2,400 | 3,000 |
| | WASP, M, 10 mph, 37% SD | | | 290 | 370 | 490 | 740 | 1,000 | 1,300 | 1,600 | 1,900 | 2,400 | 3,000 | 3,500 |
| | AT401, C, 10 mph, 25% SD | | | 320 | 450 | 640 | 950 | 1,300 | 1,800 | 2,200 | 2,600 | 3,700 | 4,900 | 5,800 |
| | WASP, C, 10 mph, 25% SD | | | 370 | 520 | 750 | 1,200 | 1,700 | 2,300 | 2,800 | 3,500 | 4,900 | 6,300 | 7,000 |
| | AT401, VC, 10 mph, 20% SD | | | 360 | 550 | 880 | 1,400 | 2,000 | 2,800 | 3,500 | 4,500 | 6,300 | 7,900 | 11,000 |
| | WASP, VC, 10 mph, 20% SD | | | 460 | 720 | 1,100 | 1,800 | 2,500 | 3,300 | 4,500 | 5,300 | 7,900 | 9,100 | 11,000 |
| | ***High Boom Very fine to Fine*** | | | 340 | 680 | 1,100 | 1,800 | 2,500 | 3,200 | 3,700 | 4,500 | 5,800 | 7,900 | 9,100 |
| | Low Boom Very fine to Fine | | | 750 | 2,000 | 3,200 | 4,900 | 6,300 | 7,900 | 9,100 | 11,000 | 13,000 | 16,000 | 21,000 |
| | High Boom Fine to Medium/Coarse | | | 1,300 | 3,300 | 4,900 | 7,000 | 9,100 | 11,000 | 13,000 | 13,000 | 16,000 | 21,000 | 21,000 |
| | Low Boom Fine to Medium/Coarse | | | 1,900 | 5,300 | 7,900 | 11,000 | 13,000 | 16,000 | 21,000 | 21,000 | 32,000 | 32,000 | 32,000 |
| | ***Sparse*** | | | 440 | 760 | 1,400 | 3,200 | 5,800 | 9,300 | 14,000 | 20,000 | 35,000 | 58,000 | 79,000 |
| Airblast | Normal | | | 21,000 | 32,000 | 49,000 | 70,000 | 110,000 | 130,000 | 160,000 | 210,000 | 210,000 | 320,000 | 320,000 |
| | Dense | | | 1,500 | 2,300 | 3,600 | 6,300 | 9,500 | 13,000 | 16,000 | 20,000 | 28,000 | 35,000 | 42,000 |
| | Vineyard | | | 7,900 | 15,000 | 29,000 | 53,000 | 79,000 | 110,000 | 130,000 | 160,000 | 210,000 | 320,000 | 320,000 |
| Flax | | | | | | | | | | | | | | |
| Aerial | ***Fine to Medium*** | 0.5 | 0.13 | 300 | 370 | 460 | 600 | 790 | 1,000 | 1,200 | 1,400 | 1,900 | 2,300 | 2,800 |
| | Medium to Coarse | | | 370 | 500 | 670 | 940 | 1,300 | 1,800 | 2,200 | 2,700 | 3,700 | 4,800 | 5,900 |
| | Coarse to Very Coarse | | | 420 | 620 | 940 | 1,500 | 2,100 | 2,800 | 3,500 | 4,300 | 5,900 | 7,700 | 9,700 |

**Table E.2. Children (1<2 years old) Risk Estimates (MOEs) Related to Indirect Exposure to Spray Drift for Malathion for the Combined Dermal and Oral Routes of Exposure**

| Crop/Rate Group | Spray Type/ Nozzle Configuration | Appl. Rate (lb ai/A) | TTR (ug/cm 2) | At Edge | 10 Feet | 25 Feet | 50 Feet | 75 Feet | 100 Feet | 125 Feet | 150 Feet | 200 Feet | 250 Feet | 300 Feet |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Groundboom | Very Fine to Fine | 0.18 | 0.05 | 210 | 230 | 250 | 300 | 340 | 390 | 440 | 500 | 610 | 720 | 810 |
| | AT401, M, 10 mph, 37% SD | | | 330 | 420 | 540 | 740 | 990 | 1,300 | 1,600 | 1,800 | 2,400 | 3,000 | 3,700 |
| | WASP, M, 10 mph, 37% SD | | | 350 | 450 | 600 | 900 | 1,200 | 1,600 | 1,900 | 2,300 | 3,000 | 3,700 | 4,300 |
| | AT401, C, 10 mph, 25% SD | | | 390 | 550 | 780 | 1,200 | 1,600 | 2,100 | 2,700 | 3,200 | 4,500 | 5,900 | 7,000 |
| | WASP, C, 10 mph, 25% SD | | | 450 | 640 | 920 | 1,500 | 2,000 | 2,800 | 3,400 | 4,300 | 5,900 | 7,700 | 8,600 |
| | AT401, VC, 10 mph, 20% SD | | | 440 | 670 | 1,100 | 1,800 | 2,500 | 3,400 | 4,300 | 5,500 | 7,700 | 9,700 | 13,000 |
| | WASP, VC, 10 mph, 20% SD | | | 560 | 880 | 1,400 | 2,100 | 3,100 | 4,100 | 5,500 | 6,400 | 9,700 | 11,000 | 13,000 |
| | ***High Boom Very fine to Fine*** | | | 410 | 830 | 1,400 | 2,200 | 3,100 | 3,900 | 4,500 | 5,500 | 7,000 | 9,700 | 11,000 |
| | Low Boom Very fine to Fine | | | 910 | 2,400 | 3,900 | 5,900 | 7,700 | 9,700 | 11,000 | 13,000 | 15,000 | 19,000 | 26,000 |
| | High Boom Fine to Medium/Coarse | | | 1,600 | 4,100 | 5,900 | 8,600 | 11,000 | 13,000 | 15,000 | 15,000 | 19,000 | 26,000 | 26,000 |
| | Low Boom Fine to Medium/Coarse | | | 2,300 | 6,400 | 9,700 | 13,000 | 15,000 | 19,000 | 26,000 | 26,000 | 39,000 | 39,000 | 39,000 |
| | ***Sparse*** | | | 540 | 930 | 1,700 | 3,900 | 7,000 | 11,000 | 17,000 | 24,000 | 43,000 | 70,000 | 97,000 |
| Airblast | Normal | | | 26,000 | 39,000 | 59,000 | 86,000 | 130,000 | 150,000 | 190,000 | 260,000 | 260,000 | 390,000 | 390,000 |
| | Dense | | | 1,800 | 2,800 | 4,400 | 7,700 | 12,000 | 16,000 | 20,000 | 24,000 | 34,000 | 43,000 | 52,000 |
| Kumquat, Tangerines | Vineyard | | | 9,700 | 19,000 | 35,000 | 64,000 | 97,000 | 130,000 | 150,000 | 190,000 | 260,000 | 390,000 | 390,000 |
| Aerial | ***Fine to Medium*** | | | 840 | 1,000 | 1,300 | 1,700 | 2,200 | 2,800 | 3,400 | 4,000 | 5,200 | 6,300 | 7,700 |
| | Medium to Coarse | | | 1,000 | 1,400 | 1,900 | 2,600 | 3,700 | 4,900 | 6,100 | 7,400 | 10,000 | 13,000 | 17,000 |
| | Coarse to Very Coarse | | | 1,200 | 1,700 | 2,600 | 4,100 | 5,800 | 7,700 | 9,800 | 12,000 | 17,000 | 21,000 | 27,000 |
| | Very Fine to Fine | | | 580 | 630 | 700 | 820 | 950 | 1,100 | 1,200 | 1,400 | 1,700 | 2,000 | 2,300 |

**Table E.2. Children (1<2 years old) Risk Estimates (MOEs) Related to Indirect Exposure to Spray Drift for Malathion for the Combined Dermal and Oral Routes of Exposure**

| Crop/Rate Group | Spray Type/ Nozzle Configuration | Appl. Rate (lb ai/A) | TTR (ug/cm 2) | At Edge | 10 Feet | 25 Feet | 50 Feet | 75 Feet | 100 Feet | 125 Feet | 150 Feet | 200 Feet | 250 Feet | 300 Feet |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Groundboom | AT401, M, 10 mph, 37% SD | | | 920 | 1,200 | 1,500 | 2,000 | 2,800 | 3,600 | 4,400 | 5,100 | 6,700 | 8,300 | 10,000 |
| | WASP, M, 10 mph, 37% SD | | | 990 | 1,300 | 1,700 | 2,500 | 3,400 | 4,400 | 5,400 | 6,300 | 8,300 | 10,000 | 12,000 |
| | AT401, C, 10 mph, 25% SD | | | 1,100 | 1,500 | 2,200 | 3,200 | 4,600 | 6,000 | 7,400 | 9,000 | 13,000 | 17,000 | 20,000 |
| | WASP, C, 10 mph, 25% SD | | | 1,300 | 1,800 | 2,600 | 4,100 | 5,700 | 7,700 | 9,300 | 12,000 | 17,000 | 21,000 | 24,000 |
| | AT401, VC, 10 mph, 20% SD | | | 1,200 | 1,900 | 3,000 | 4,900 | 6,900 | 9,300 | 12,000 | 15,000 | 21,000 | 27,000 | 36,000 |
| | WASP, VC, 10 mph, 20% SD | | | 1,600 | 2,400 | 3,800 | 6,000 | 8,600 | 11,000 | 15,000 | 18,000 | 27,000 | 31,000 | 36,000 |
| | ***High Boom Very fine to Fine*** | | | 1,100 | 2,300 | 3,800 | 6,100 | 8,600 | 11,000 | 13,000 | 15,000 | 20,000 | 27,000 | 31,000 |
| | Low Boom Very fine to Fine | | | 2,500 | 6,700 | 11,000 | 17,000 | 21,000 | 27,000 | 31,000 | 36,000 | 43,000 | 54,000 | 72,000 |
| | High Boom Fine to Medium/Coarse | | | 4,400 | 11,000 | 17,000 | 24,000 | 31,000 | 36,000 | 43,000 | 43,000 | 54,000 | 72,000 | 72,000 |
| | Low Boom Fine to Medium/Coarse | | | 6,500 | 18,000 | 27,000 | 36,000 | 43,000 | 54,000 | 72,000 | 72,000 | 110,000 | 110,000 | 110,000 |
| Airblast | ***Sparse*** | | | 1,500 | 2,600 | 4,800 | 11,000 | 20,000 | 32,000 | 48,000 | 67,000 | 120,000 | 200,000 | 270,000 |
| | Normal | | | 72,000 | 110,000 | 170,000 | 240,000 | 360,000 | 430,000 | 540,000 | 720,000 | 720,000 | 1,100,000 | 1,100,000 |
| | Dense | | | 5,100 | 7,700 | 12,000 | 21,000 | 32,000 | 44,000 | 55,000 | 67,000 | 93,000 | 120,000 | 140,000 |
| | Vineyard | | | 27,000 | 52,000 | 98,000 | 180,000 | 270,000 | 360,000 | 430,000 | 540,000 | 720,000 | 1,100,000 | 1,100,000 |

# Appendix H: Details of Malathion and Malaoxon Air Monitoring Studies

- CDPR Air Monitoring Network (AMN) program – 2011-2014 (CDPR) http://www.cdpr.ca.gov/docs/emon/airinit/air_network_results.htm
    - CDPR has established a monitoring network to sample ambient air for multiple pesticides in three communities on a regular schedule
        - Ripon (San Joaquin County, approximately 20 miles south of Stockton)
        - Salinas (Monterey County, approximately 60 miles south of San Jose)
        - Shafter (Kern County, approximately 20 miles northwest of Bakersfield)
    - CDPR designed the study to collect one 24-hour sample each week over a multiple year sampling duration.
    - Data from years 2011 through 2014 is provided.
    - AMN analyzed data for malathion and malaoxon at the Salinas, Shafter, and Ripon locations, most 24-hour samples are found to be trace or non-detect.

- Lompoc, CA Ambient Air Monitoring (2003) (CalDPR) http://www.cdpr.ca.gov/docs/specproj/lompoc/lompoc.htm
    - Ambient air monitoring of 22 pesticides and five oxygen analog breakdown products (including malathion and malaoxon) simultaneously during the peak use period for most of the pesticides, between May 31 and August 3, 2000.
    - DPR collected 24-hour samples, four consecutive days per week at each of four monitoring locations.
    - Four sampling sites were located within the city limits of Lompoc, one each in the northwest, central-west, southwest, and near the center of Lompoc. These sites plus an additional site on the northeast side of Lompoc were used.
    - Samplers at all locations were on rooftops to ensure the security of the samples.
    - DPR maintains a database of all agricultural pesticide applications in California, including date applied, amount applied, and application location.
    - Of the 31 pesticides or breakdown products monitored, DPR detected 27 of them in one or more of the 451 samples collected and analyzed.
        - Highest one-day air concentration for malathion = 7.6 ng/$m^3$
        - Highest one-day air concentration for malaoxon = 2.2 ng/$m^3$
        - Highest 14-day air concentration for malathion = 2.47 ng/$m^3$
        - Highest 14-day air concentration for malaoxon = 0.85 ng/$m^3$
        - Highest 10-week air concentration for malathion = 1.23 ng/$m^3$
        - Highest 10-week air concentration for malaoxon = 0.43 ng/$m^3$

- Imperial County, CA – Application and Air Monitoring 1999 (CARB) http://www.cdpr.ca.gov/docs/emon/pubs/tac/tacpdfs/mala99fe.pdf
    - Conducted air monitoring over a three week period to coincide with application of malathion on alfalfa.
    - Aerial application of malathion coincided with a three day monitoring period (February 25-27, 1998). Four samplers were positioned on each side of the field. A fifth samplers was collocated at the east position.
        - Of the 28 samples collected for malathion (spikes, blanks, collocated and background sampled excluded), 27 samples were found to be above the

estimated quantitation limit (EQL) with the highest concentration observed of 2400 ng/$m^3$
    - Of the 28 samples collected for malaoxon (spikes, blanks, collocated and background sampled excluded), 12 samples were found to be above EQL with the highest concentration observed of 440 ng/$m^3$
- Ambient air 24 hour monitoring sampling was conducted from February 23-March 13, 1998
    - Of the 60 samples collected for malathion (spikes, blanks, collocated and background sampled excluded), 27 samples were found to be above EQL with the highest concentration observed of 90 ng/$m^3$ and the highest average concentration is 19 ng/$m^3$ from the Calipatria School District Bus Barn.
    - Of the 60 samples collected for malaoxon (spikes, blanks, collocated and background sampled excluded), 22 samples were found to be above EQL with the highest concentration observed of 28 ng/$m^3$ and the highest average concentration is 13 ng/$m^3$ from the Pine Elementary School.

- Parlier, CA – Ambient Air Monitoring 2009 (CDPR and CARB) http://www.cdpr.ca.gov/docs/envjust/pilot_proj/parlier_final.pdf
    - Collected ambient air samples over 12 months from January 3- December 28, 2006
    - Sampling stations were positioned at three elementary schools in Parlier
    - Of the potentially 468 samples, malathion was levels were quantifiable in 1 sample and malaoxon in 5 samples.
        - Highest one-day air concentration for malathion = 21 ng/$m^3$
        - Highest one-day air concentration for malaoxon = 16 ng/$m^3$
        - Highest 14-day air concentration for malathion = 3.14 ng/$m^3$
        - Highest 14-day air concentration for malaoxon = 3.6 ng/$m^3$
        - One year average air concentration for malathion = 1.17 ng/$m^3$
        - One year average air concentration for malaoxon = 0.81 ng/$m^3$

- Monterey County, CA – Ambient Air Monitoring 1985 (CDPR) http://www.cdpr.ca.gov/docs/emon/pubs/ehapreps/eh8507.pdf
    - Collected ambient air samples at residential sites from June 18-21, 1985
    - Three sites were selected for sampling, all within close proximity to agricultural lands
    - The samplers were analyzed for phosdrin, lannate, and screened for organophosphates, malathion was not specifically analyzed.
        - No malathion specific analysis was conducted and no results were reported.

- Yakima Valley and North Central, Washington- Residential air monitoring and monitoring at the edge of treated orchards http://www.doh.wa.gov/Portals/1/Documents/4300/Pesticide-UW-OP-Summary.pdf

- Three samplers were located outside different houses that were within 100 meters of an orchard. An additional sampler was located away from orchards (more than 1,000 meters from the nearest orchard)
- Researchers did not know whether the orchards near each sampler were actually treated with pesticides of interest (chlorpyrifos, azinphos-methyl, phosmet, and malathion)
- Samples were collected every other day for at least 28 days during peak chlorpyrifos application periods (March – April 2008) and every third day during peak azinphos-methyl application periods (May – June 2008)
    - Concentrations of malathion measures were less than 1 $ng/m^3$

# Appendix I:  Summary of Occupational Handler Risk Assessment for Malathion

**Table I.1: Liquid Concentrate Formulations: Agricultural Non-ULV Applications Dermal Risks**
**Summary of Malathion Occupational Handler Short- and Intermediate-Term Dermal Risks**

| Exposure Scenario | Crop | App. Rate[c] (lb ai/A or /Gal) | Amount Handled Per Day[d] (A or Gal) | Level of Personal Protective Equipment for Dermal Exposures Dermal MOE[a] – LOC[b] = 1000 | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | | | Baseline[e] | SL/GL[f] | DL/GL[g] | SL/GL/CRH | DL/GL/CRH[i] | Eng. Controls[j] |
| **Mixer/Loaders** | | | | | | | | | |
| Mixing/Loading to Support Aerial Applications | CA ONLY: Grapefruit, Lemon, Lime, Orange, Tangelo, Tangerine | 7.5 lb ai/A | 350 acres | 9.5 | 56 | 72 | No Data | No Data | 240 |
| | Avocado | 4.75 lb ai/A | 350 acres | 15 | 88 | 110 | No Data | No Data | 390 |
| | Grapefruit, Lemon, Lime, Orange, Tangelo, Tangerine | 4.5 lb ai/A | 350 acres | 16 | 93 | 120 | No Data | No Data | 410 |
| | Kumquat | 4.5 lb ai/A | 350 acres | 16 | 93 | 120 | No Data | No Data | 410 |
| | Pine Seed Orchards, Christmas Tree Plantations | 3.2 lb ai/A | 1200 acres | 6.6 | 38 | 49 | No Data | No Data | 170 |
| | Nectarine, Peach | 3 lb ai/A | 350 acres | 24 | 140 | 180 | No Data | No Data | 610 |
| | Cotton | 2.5 lb ai/A | 1200 acres | 8.4 | 49 | 63 | No Data | No Data | 210 |
| | Chestnut, Pecans, Walnuts | 2.5 lb ai/A | 350 acres | 29 | 170 | 220 | No Data | No Data | 730 |
| | Strawberry | 2 lb ai/A | 350 acres | 36 | 210 | 270 | No Data | No Data | 920 |
| | Figs | 2 lb ai/A | 350 acres | 36 | 210 | 270 | No Data | No Data | 920 |
| | Spinach | 2 lb ai/A | 350 acres | 36 | 210 | 270 | No Data | No Data | 920 |
| | Pineapple | 2 lb ai/A | 350 acres | 36 | 210 | 270 | No Data | No Data | 920 |
| | Blackberry, Boysenberry, Dewberry, Loganberry, Raspberry | 2 lb ai/A | 350 acres | 36 | 210 | 270 | No Data | No Data | 920 |
| | Gooseberry | 2 lb ai/A | 350 acres | 36 | 210 | 270 | No Data | No Data | 920 |
| | Lettuce, head and leaf | 1.88 lb ai/A | 350 acres | 38 | 220 | 290 | No Data | No Data | 980 |
| | Grapes (raisin, table, wine) | 1.88 lb ai/A | 350 acres | 38 | 220 | 290 | No Data | No Data | 980 |

**Table I.1: Liquid Concentrate Formulations: Agricultural Non-ULV Applications Dermal Risks**
**Summary of Malathion Occupational Handler Short- and Intermediate-Term Dermal Risks**

| Exposure Scenario | Crop | App. Rate[c] (lb ai/A or /Gal) | Amount Handled Per Day[d] (A or Gal) | Level of Personal Protective Equipment for Dermal Exposures Dermal MOE[a] – LOC[b] = 1000 | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | | | Baseline[e] | SL/GL[f] | DL/GL[g] | SL/GL/CRH | DL/GL/CRH[i] | Eng. Controls[j] |
| Mixing/Loading to Support Aerial Applications | Cherry (Sweet and Tart) | 1.75 lb ai/A | 350 acres | 41 | 240 | 310 | No Data | No Data | 1000 |
| | Chayote Fruit, Cucumber, Summer Squash | 1.75 lb ai/A | 350 acres | 41 | 240 | 310 | No Data | No Data | 1000 |
| | Eggplant, Oriental Eggplant, Pepper, Tomato, Tomatillo | 1.56 lb ai/A | 350 acres | 46 | 270 | 350 | No Data | No Data | 1200 |
| | Chayote Root, Garlic, Leeks, Onion, Potatoes, Shallot, Sweet Potatoes, Yams | 1.56 lb ai/A | 350 acres | 46 | 270 | 350 | No Data | No Data | 1200 |
| | Apricot | 1.5 lb ai/A | 350 acres | 48 | 280 | 360 | No Data | No Data | 1200 |
| | Grapefruit, Lemon, Lime, Orange, Tangelo, Tangerine | 1.5 lb ai/A | 350 acres | 48 | 280 | 360 | No Data | No Data | 1200 |
| | Watermelon | 1.5 lb ai/A | 350 acres | 48 | 280 | 360 | No Data | No Data | 1200 |
| | Celery, Parsley | 1.5 lb ai/A | 350 acres | 48 | 280 | 360 | No Data | No Data | 1200 |
| | Barley, Rice, Wild Rice | 1.25 lb ai/A | 1200 acres | 17 | 98 | 130 | No Data | No Data | 430 |
| | Grass - Forage and Hay | 1.25 lb ai/A | 1200 acres | 17 | 98 | 130 | No Data | No Data | 430 |
| | Alfalfa, Birdsfoot Trefoil, Clover | 1.25 lb ai/A | 1200 acres | 17 | 98 | 130 | No Data | No Data | 430 |
| | Blueberry (lowbush) | 1.25 lb ai/A | 350 acres | 57 | 330 | 430 | No Data | No Data | 1500 |
| | Lespedeza, Vetch | 1.25 lb ai/A | 350 acres | 57 | 330 | 430 | No Data | No Data | 1500 |
| | Bermuda Grass | 1.25 lb ai/A | 350 acres | 57 | 330 | 430 | No Data | No Data | 1500 |
| | Pear | 1.25 lb ai/A | 350 acres | 57 | 330 | 430 | No Data | No Data | 1500 |
| | FL ONLY: Lemon | 1.25 lb ai/A | 350 acres | 57 | 330 | 430 | No Data | No Data | 1500 |
| | Guava, Papaya | 1.25 lb ai/A | 350 acres | 57 | 330 | 430 | No Data | No Data | 1500 |

**Table I.1: Liquid Concentrate Formulations: Agricultural Non-ULV Applications Dermal Risks**
**Summary of Malathion Occupational Handler Short- and Intermediate-Term Dermal Risks**

| Exposure Scenario | Crop | App. Rate[c] (lb ai/A or /Gal) | Amount Handled Per Day[d] (A or Gal) | Level of Personal Protective Equipment for Dermal Exposures Dermal MOE[a] – LOC[b] = 1000 | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | | | Baseline[e] | SL/GL[f] | DL/GL[g] | SL/GL/CRH | DL/GL/CRH[i] | Eng. Controls[j] |
| Mixing/Loading to Support Aerial Applications | Broccoli, Broccoli Raab, Brussels Sprouts, Cabbage, Cauliflower, Chinese Broccoli, Dandelion | 1.25 lb ai/A | 350 acres | 57 | 330 | 430 | No Data | No Data | 1500 |
| | Endive. Kohlrabi, Chinese Greens, Watercress | 1.25 lb ai/A | 350 acres | 57 | 330 | 430 | No Data | No Data | 1500 |
| | Carrot, Garden Beets, Horseradish, Parsnip, Salsify, Turnip (greens & roots) | 1.25 lb ai/A | 350 acres | 57 | 330 | 430 | No Data | No Data | 1500 |
| | Asparagus | 1.25 lb ai/A | 350 acres | 57 | 330 | 430 | No Data | No Data | 1500 |
| | Blueberry (highbush), Currant | 1.25 lb ai/A | 350 acres | 57 | 330 | 430 | No Data | No Data | 1500 |
| | Okra | 1.2 lb ai/A | 350 acres | 60 | 350 | 450 | No Data | No Data | 1500 |
| | Oats, Rye, Spring Wheat, Winter Wheat | 1 lb ai/A | 1200 acres | 21 | 120 | 160 | No Data | No Data | 540 |
| | Corn (field), Sorghum | 1 lb ai/A | 1200 acres | 21 | 120 | 160 | No Data | No Data | 540 |
| | Peas - Succulent | 1 lb ai/A | 350 acres | 71 | 420 | 540 | No Data | No Data | 1800 |
| | Corn (pop and sweet) | 1 lb ai/A | 350 acres | 71 | 420 | 540 | No Data | No Data | 1800 |
| | Cantaloupe, Melon, Pumpkin, Winter Squash | 1 lb ai/A | 350 acres | 71 | 420 | 540 | No Data | No Data | 1800 |
| | Collard, Kale, Mustard Green, Swiss Chard | 1 lb ai/A | 350 acres | 71 | 420 | 540 | No Data | No Data | 1800 |
| | Peas - Succulent | 1 lb ai/A | 350 acres | 71 | 420 | 540 | No Data | No Data | 1800 |
| | Radish, Rutabaga | 1 lb ai/A | 350 acres | 71 | 420 | 540 | No Data | No Data | 1800 |
| | Passion Fruit | 1 lb ai/A | 350 acres | 71 | 420 | 540 | No Data | No Data | 1800 |
| | Mint | 0.94 lb ai/A | 350 acres | 76 | 440 | 580 | No Data | No Data | 2000 |

**Table I.1: Liquid Concentrate Formulations: Agricultural Non-ULV Applications Dermal Risks**
**Summary of Malathion Occupational Handler Short- and Intermediate-Term Dermal Risks**

| Exposure Scenario | Crop | App. Rate[c] (lb ai/A or /Gal) | Amount Handled Per Day[d] (A or Gal) | Level of Personal Protective Equipment for Dermal Exposures Dermal MOE[a] – LOC[b] = 1000 | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | | | Baseline[e] | SL/GL[f] | DL/GL[g] | SL/GL/CRH | DL/GL/CRH[i] | Eng. Controls[j] |
| Mixing/Loading to Support Aerial Applications | Mango | 0.94 lb ai/A | 350 acres | 76 | 440 | 580 | No Data | No Data | 2000 |
| | Macadamia Nut | 0.94 lb ai/A | 350 acres | 76 | 440 | 580 | No Data | No Data | 2000 |
| | Hops | 0.63 lb ai/A | 350 acres | 110 | 670 | 860 | No Data | No Data | 2900 |
| | Flax | 0.5 lb ai/A | 1200 acres | 42 | 240 | 310 | No Data | No Data | 1100 |
| | Flowers and Foliage Grown for Cutting | 0.25 lb ai/A | 60 acres | 1700 | 9800 | 13000 | No Data | No Data | 43000 |
| | Flowers, Shrubs, Flowering Plants, Nursery Stock, Woody Plants, Shade Trees (nursery grown) | 0.25 lb ai/A | 60 acres | 1700 | 9800 | 13000 | No Data | No Data | 43000 |
| | Flowers, Shrubs, Flowering Plants, Nursery Stock, Woody Plants, Shade Trees (field grown) | 0.25 lb ai/A | 40 acres | 2500 | 15000 | 19000 | No Data | No Data | 64000 |
| Mixing/Loading to Support Chemigation Applications | CA ONLY: Grapefruit, Lemon, Lime, Orange, Tangelo, Tangerine | 7.5 lb ai/A | 350 acres | 9.5 | 56 | 72 | No Data | No Data | 240 |
| | Avocado | 4.75 lb ai/A | 350 acres | 15 | 88 | 110 | No Data | No Data | 390 |
| | Grapefruit, Lemon, Lime, Orange, Tangelo, Tangerine | 4.5 lb ai/A | 350 acres | 16 | 93 | 120 | No Data | No Data | 410 |
| | Kumquat | 4.5 lb ai/A | 350 acres | 16 | 93 | 120 | No Data | No Data | 410 |
| | Pine Seed Orchards, Christmas Tree Plantations | 3.2 lb ai/A | 350 acres | 22 | 130 | 170 | No Data | No Data | 570 |
| | Nectarine, Peach | 3 lb ai/A | 350 acres | 24 | 140 | 180 | No Data | No Data | 610 |
| | Cotton | 2.5 lb ai/A | 350 acres | 29 | 170 | 220 | No Data | No Data | 730 |
| | Chestnut, Pecans, Walnuts | 2.5 lb ai/A | 350 acres | 29 | 170 | 220 | No Data | No Data | 730 |
| | Strawberry | 2 lb ai/A | 350 acres | 36 | 210 | 270 | No Data | No Data | 920 |

**Table I.1: Liquid Concentrate Formulations: Agricultural Non-ULV Applications Dermal Risks**
**Summary of Malathion Occupational Handler Short- and Intermediate-Term Dermal Risks**

| Exposure Scenario | Crop | App. Rate[c] (lb ai/A or /Gal) | Amount Handled Per Day[d] (A or Gal) | Level of Personal Protective Equipment for Dermal Exposures Dermal MOE[a] – LOC[b] = 1000 | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | | | Baseline[e] | SL/GL[f] | DL/GL[g] | SL/GL/CRH | DL/GL/CRH[i] | Eng. Controls[j] |
| Mixing/Loading to Support Chemigation Applications | Figs | 2 lb ai/A | 350 acres | 36 | 210 | 270 | No Data | No Data | 920 |
| | Spinach | 2 lb ai/A | 350 acres | 36 | 210 | 270 | No Data | No Data | 920 |
| | Pineapple | 2 lb ai/A | 350 acres | 36 | 210 | 270 | No Data | No Data | 920 |
| | Blackberry, Boysenberry, Dewberry, Loganberry, Raspberry | 2 lb ai/A | 350 acres | 36 | 210 | 270 | No Data | No Data | 920 |
| | Gooseberry | 2 lb ai/A | 350 acres | 36 | 210 | 270 | No Data | No Data | 920 |
| | Lettuce, head and leaf | 1.88 lb ai/A | 350 acres | 38 | 220 | 290 | No Data | No Data | 980 |
| | Grapes (raisin, table, wine) | 1.88 lb ai/A | 350 acres | 38 | 220 | 290 | No Data | No Data | 980 |
| | Cherry (Sweet and Tart) | 1.75 lb ai/A | 350 acres | 41 | 240 | 310 | No Data | No Data | 1000 |
| | Chayote Fruit, Cucumber, Summer Squash | 1.75 lb ai/A | 350 acres | 41 | 240 | 310 | No Data | No Data | 1000 |
| | Eggplant, Oriental Eggplant, Pepper, Tomato, Tomatillo | 1.56 lb ai/A | 350 acres | 46 | 270 | 350 | No Data | No Data | 1200 |
| | Chayote Root, Garlic, Leeks, Onion, Potatoes, Shallot, Sweet Potatoes, Yams | 1.56 lb ai/A | 350 acres | 46 | 270 | 350 | No Data | No Data | 1200 |
| | Apricot | 1.5 lb ai/A | 350 acres | 48 | 280 | 360 | No Data | No Data | 1200 |
| | Grapefruit, Lemon, Lime, Orange, Tangelo, Tangerine | 1.5 lb ai/A | 350 acres | 48 | 280 | 360 | No Data | No Data | 1200 |
| | Watermelon | 1.5 lb ai/A | 350 acres | 48 | 280 | 360 | No Data | No Data | 1200 |
| | Celery, Parsley | 1.5 lb ai/A | 350 acres | 48 | 280 | 360 | No Data | No Data | 1200 |
| | Alfalfa, Birdsfoot Trefoil, Clover | 1.25 lb ai/A | 1200 acres | 17 | 98 | 130 | No Data | No Data | 430 |
| | Blueberry (lowbush) | 1.25 lb ai/A | 350 acres | 57 | 330 | 430 | No Data | No Data | 1500 |
| | Barley, Rice, Wild Rice | 1.25 lb ai/A | 350 acres | 57 | 330 | 430 | No Data | No Data | 1500 |
| | Grass - Forage and Hay | 1.25 lb ai/A | 350 acres | 57 | 330 | 430 | No Data | No Data | 1500 |
| | Lespedeza, Vetch | 1.25 lb ai/A | 350 acres | 57 | 330 | 430 | No Data | No Data | 1500 |
| | Bermuda Grass | 1.25 lb ai/A | 350 acres | 57 | 330 | 430 | No Data | No Data | 1500 |
| | Pear | 1.25 lb ai/A | 350 acres | 57 | 330 | 430 | No Data | No Data | 1500 |

**Table I.1: Liquid Concentrate Formulations: Agricultural Non-ULV Applications Dermal Risks**
**Summary of Malathion Occupational Handler Short- and Intermediate-Term Dermal Risks**

| Exposure Scenario | Crop | App. Rate[c] (lb ai/A or /Gal) | Amount Handled Per Day[d] (A or Gal) | Level of Personal Protective Equipment for Dermal Exposures Dermal MOE[a] – LOC[b] = 1000 | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | | | Baseline[e] | SL/GL[f] | DL/GL[g] | SL/GL/CRH | DL/GL/CRH[i] | Eng. Controls[j] |
| Mixing/Loading to Support Chemigation Applications | FL ONLY: Lemon | 1.25 lb ai/A | 350 acres | 57 | 330 | 430 | No Data | No Data | 1500 |
| | Guava, Papaya | 1.25 lb ai/A | 350 acres | 57 | 330 | 430 | No Data | No Data | 1500 |
| | Broccoli, Broccoli Raab, Brussels Sprouts, Cabbage, Cauliflower, Chinese Broccoli, Dandelion | 1.25 lb ai/A | 350 acres | 57 | 330 | 430 | No Data | No Data | 1500 |
| | Endive. Kohlrabi, Chinese Greens, Watercress | 1.25 lb ai/A | 350 acres | 57 | 330 | 430 | No Data | No Data | 1500 |
| | Carrot, Garden Beets, Horseradish, Parsnip, Salsify, Turnip (greens & roots) | 1.25 lb ai/A | 350 acres | 57 | 330 | 430 | No Data | No Data | 1500 |
| | Asparagus | 1.25 lb ai/A | 350 acres | 57 | 330 | 430 | No Data | No Data | 1500 |
| | Blueberry (highbush), Currant | 1.25 lb ai/A | 350 acres | 57 | 330 | 430 | No Data | No Data | 1500 |
| | Okra | 1.2 lb ai/A | 350 acres | 60 | 350 | 450 | No Data | No Data | 1500 |
| | Oats, Rye, Spring Wheat, Winter Wheat | 1 lb ai/A | 350 acres | 71 | 420 | 540 | No Data | No Data | 1800 |
| | Peas - Succulent | 1 lb ai/A | 350 acres | 71 | 420 | 540 | No Data | No Data | 1800 |
| | Corn (field), Sorghum | 1 lb ai/A | 350 acres | 71 | 420 | 540 | No Data | No Data | 1800 |
| | Corn (pop and sweet) | 1 lb ai/A | 350 acres | 71 | 420 | 540 | No Data | No Data | 1800 |
| | Cantaloupe, Melon, Pumpkin, Winter Squash | 1 lb ai/A | 350 acres | 71 | 420 | 540 | No Data | No Data | 1800 |
| | Collard, Kale, Mustard Green, Swiss Chard | 1 lb ai/A | 350 acres | 71 | 420 | 540 | No Data | No Data | 1800 |
| | Peas - Succulent | 1 lb ai/A | 350 acres | 71 | 420 | 540 | No Data | No Data | 1800 |
| | Radish, Rutabaga | 1 lb ai/A | 350 acres | 71 | 420 | 540 | No Data | No Data | 1800 |
| | Passion Fruit | 1 lb ai/A | 350 acres | 71 | 420 | 540 | No Data | No Data | 1800 |
| | Flowers and Foliage Grown for Cutting | 1 lb ai/A | 60 acres | 420 | 2400 | 3100 | No Data | No Data | 11000 |
| | Flowers, Shrubs, Flowering Plants, Nursery | 1 lb ai/A | 60 acres | 420 | 2400 | 3100 | No Data | No Data | 11000 |

**Table I.1: Liquid Concentrate Formulations: Agricultural Non-ULV Applications Dermal Risks**
**Summary of Malathion Occupational Handler Short- and Intermediate-Term Dermal Risks**

| Exposure Scenario | Crop | App. Rate[c] (lb ai/A or /Gal) | Amount Handled Per Day[d] (A or Gal) | Level of Personal Protective Equipment for Dermal Exposures Dermal MOE[a] – LOC[b] = 1000 | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | | | Baseline[e] | SL/GL[f] | DL/GL[g] | SL/GL/CRH | DL/GL/CRH[i] | Eng. Controls[j] |
| Mixing/Loading to Support Chemigation Applications | Stock, Woody Plants, Shade Trees (nursery grown) Flowers, Shrubs, Flowering Plants, Nursery Stock, Woody Plants, Shade Trees (field grown) | 1 lb ai/A | 40 acres | 630 | 3700 | 4800 | No Data | No Data | 16000 |
| | Mint | 0.94 lb ai/A | 350 acres | 76 | 440 | 580 | No Data | No Data | 2000 |
| | Mango | 0.94 lb ai/A | 350 acres | 76 | 440 | 580 | No Data | No Data | 2000 |
| | Macadamia Nut | 0.94 lb ai/A | 350 acres | 76 | 440 | 580 | No Data | No Data | 2000 |
| | Hops | 0.63 lb ai/A | 350 acres | 110 | 670 | 860 | No Data | No Data | 2900 |
| | Flax | 0.5 lb ai/A | 350 acres | 140 | 840 | 1100 | No Data | No Data | 3700 |
| | Cotton | 2.5 lb ai/A | 200 acres | 50 | 290 | 380 | No Data | No Data | 1300 |
| | Strawberry | 2 lb ai/A | 80 acres | 160 | 920 | 1200 | No Data | No Data | 4000 |
| | Spinach | 2 lb ai/A | 80 acres | 160 | 920 | 1200 | No Data | No Data | 4000 |
| | Pineapple | 2 lb ai/A | 80 acres | 160 | 920 | 1200 | No Data | No Data | 4000 |
| Mixing/Loading to Support Groundboom Applications | Blackberry, Boysenberry, Dewberry, Loganberry, Raspberry | 2 lb ai/A | 80 acres | 160 | 920 | 1200 | No Data | No Data | 4000 |
| | Gooseberry | 2 lb ai/A | 80 acres | 160 | 920 | 1200 | No Data | No Data | 4000 |
| | Lettuce, head and leaf | 1.88 lb ai/A | 80 acres | 170 | 980 | 1300 | No Data | No Data | 4300 |
| | Grapes (raisin, table, wine) | 1.88 lb ai/A | 80 acres | 170 | 980 | 1300 | No Data | No Data | 4300 |
| | Chayote Fruit, Cucumber, Summer Squash | 1.75 lb ai/A | 80 acres | 180 | 1000 | 1400 | No Data | No Data | 4600 |
| | Eggplant, Oriental Eggplant, Pepper, Tomato, Tomatillo | 1.56 lb ai/A | 80 acres | 200 | 1200 | 1500 | No Data | No Data | 5200 |

**Table I.1: Liquid Concentrate Formulations: Agricultural Non-ULV Applications Dermal Risks**
**Summary of Malathion Occupational Handler Short- and Intermediate-Term Dermal Risks**

| Exposure Scenario | Crop | App. Rate[c] (lb ai/A or /Gal) | Amount Handled Per Day[d] (A or Gal) | Level of Personal Protective Equipment for Dermal Exposures Dermal MOE[a] – LOC[b] = 1000 | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | | | Baseline[e] | SL/GL[f] | DL/GL[g] | SL/GL/CRH | DL/GL/CRH[i] | Eng. Controls[j] |
| Mixing/Loading to Support Groundboom Applications | Chayote Root, Garlic, Leeks, Onion, Potatoes, Shallot, Sweet Potatoes, Yams | 1.56 lb ai/A | 80 acres | 200 | 1200 | 1500 | No Data | No Data | 5200 |
| | Watermelon | 1.5 lb ai/A | 80 acres | 210 | 1200 | 1600 | No Data | No Data | 5400 |
| | Celery, Parsley | 1.5 lb ai/A | 80 acres | 210 | 1200 | 1600 | No Data | No Data | 5400 |
| | Barley, Rice, Wild Rice | 1.25 lb ai/A | 200 acres | 100 | 590 | 750 | No Data | No Data | 2600 |
| | Grass - Forage and Hay | 1.25 lb ai/A | 200 acres | 100 | 590 | 750 | No Data | No Data | 2600 |
| | Alfalfa, Birdsfoot Trefoil, Clover | 1.25 lb ai/A | 200 acres | 100 | 590 | 750 | No Data | No Data | 2600 |
| | Blueberry (lowbush) | 1.25 lb ai/A | 80 acres | 250 | 1500 | 1900 | No Data | No Data | 6400 |
| | Lespedeza, Vetch | 1.25 lb ai/A | 80 acres | 250 | 1500 | 1900 | No Data | No Data | 6400 |
| | Bermuda Grass | 1.25 lb ai/A | 80 acres | 250 | 1500 | 1900 | No Data | No Data | 6400 |
| | | 1.25 lb ai/A | 80 acres | 250 | 1500 | 1900 | No Data | No Data | 6400 |
| | Broccoli, Broccoli Raab, Brussels Sprouts, Cabbage, Cauliflower, Chinese Broccoli, Dandelion | 1.25 lb ai/A | 80 acres | 250 | 1500 | 1900 | No Data | No Data | 6400 |
| | Endive. Kohlrabi, Chinese Greens, Watercress | 1.25 lb ai/A | 80 acres | 250 | 1500 | 1900 | No Data | No Data | 6400 |
| | Carrot, Garden Beets, Horseradish, Parsnip, Salsify, Turnip (greens & roots) | 1.25 lb ai/A | 80 acres | 250 | 1500 | 1900 | No Data | No Data | 6400 |
| | Asparagus | 1.25 lb ai/A | 80 acres | 250 | 1500 | 1900 | No Data | No Data | 6400 |
| | Blueberry (highbush), Currant | 1.25 lb ai/A | 80 acres | 250 | 1500 | 1900 | No Data | No Data | 6400 |
| | Okra | 1.2 lb ai/A | 80 acres | 260 | 1500 | 2000 | No Data | No Data | 6700 |
| | Oats, Rye, Spring Wheat, Winter Wheat | 1 lb ai/A | 200 acres | 130 | 730 | 950 | No Data | No Data | 3200 |
| | Corn (field), Sorghum | 1 lb ai/A | 200 acres | 130 | 730 | 950 | No Data | No Data | 3200 |

**Table I.1: Liquid Concentrate Formulations: Agricultural Non-ULV Applications Dermal Risks**
**Summary of Malathion Occupational Handler Short- and Intermediate-Term Dermal Risks**

| Exposure Scenario | Crop | App. Rate[c] (lb ai/A or /Gal) | Amount Handled Per Day[d] (A or Gal) | Level of Personal Protective Equipment for Dermal Exposures Dermal MOE[a] – LOC[b] = 1000 | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | | | Baseline[e] | SL/GL[f] | DL/GL[g] | SL/GL/CRH | DL/GL/CRH[i] | Eng. Controls[j] |
| Mixing/Loading to Support Groundboom Applications | Peas - Succulent | 1 lb ai/A | 80 acres | 310 | 1800 | 2400 | No Data | No Data | 8000 |
| | Corn (pop and sweet) | 1 lb ai/A | 80 acres | 310 | 1800 | 2400 | No Data | No Data | 8000 |
| | Cantaloupe, Melon, Pumpkin, Winter Squash | 1 lb ai/A | 80 acres | 310 | 1800 | 2400 | No Data | No Data | 8000 |
| | Collard, Kale, Mustard Green, Swiss Chard | 1 lb ai/A | 80 acres | 310 | 1800 | 2400 | No Data | No Data | 8000 |
| | Peas - Succulent | 1 lb ai/A | 80 acres | 310 | 1800 | 2400 | No Data | No Data | 8000 |
| | Radish, Rutabaga | 1 lb ai/A | 80 acres | 310 | 1800 | 2400 | No Data | No Data | 8000 |
| | Passion Fruit | 1 lb ai/A | 80 acres | 310 | 1800 | 2400 | No Data | No Data | 8000 |
| | Flowers and Foliage Grown for Cutting | 1 lb ai/A | 60 acres | 420 | 2400 | 3100 | No Data | No Data | 11000 |
| | Flowers, Shrubs, Flowering Plants, Nursery Stock, Woody Plants, Shade Trees (nursery grown) | 1 lb ai/A | 60 acres | 420 | 2400 | 3100 | No Data | No Data | 11000 |
| | Flowers, Shrubs, Flowering Plants, Nursery Stock, Woody Plants, Shade Trees (field grown) | 1 lb ai/A | 40 acres | 630 | 3700 | 4800 | No Data | No Data | 16000 |
| | Mint | 0.94 lb ai/A | 80 acres | 330 | 2000 | 2500 | No Data | No Data | 8500 |
| | Hops | 0.63 lb ai/A | 80 acres | 500 | 2900 | 3800 | No Data | No Data | 13000 |
| | Flax | 0.5 lb ai/A | 200 acres | 250 | 1500 | 1900 | No Data | No Data | 6400 |

**Table I.1: Liquid Concentrate Formulations: Agricultural Non-ULV Applications Dermal Risks**
**Summary of Malathion Occupational Handler Short- and Intermediate-Term Dermal Risks**

| Exposure Scenario | Crop | App. Rate[c] (lb ai/A or /Gal) | Amount Handled Per Day[d] (A or Gal) | Level of Personal Protective Equipment for Dermal Exposures Dermal MOE[a] – LOC[b] = 1000 | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | | | Baseline[e] | SL/GL[f] | DL/GL[g] | SL/GL/CRH | DL/GL/CRH[i] | Eng. Controls[j] |
| Mixing/Loading to Support Airblast Applications | Flowers and Foliage Grown for Cutting | 10 lb ai/A | 20 acres | 130 | 730 | 950 | No Data | No Data | 3200 |
| | Flowers, Shrubs, Flowering Plants, Nursery Stock, Woody Plants, Shade Trees (nursery grown) | 10 lb ai/A | 20 acres | 130 | 730 | 950 | No Data | No Data | 3200 |
| | Flowers, Shrubs, Flowering Plants, Nursery Stock, Woody Plants, Shade Trees (field grown) | 10 lb ai/A | 10 acres | 250 | 1500 | 1900 | No Data | No Data | 6400 |
| | CA ONLY: Grapefruit, Lemon, Lime, Orange, Tangelo, Tangerine | 7.5 lb ai/A | 40 acres | 84 | 490 | 630 | No Data | No Data | 2100 |
| | Avocado | 4.75 lb ai/A | 40 acres | 130 | 780 | 1000 | No Data | No Data | 3400 |
| | Grapefruit, Lemon, Lime, Orange, Tangelo, Tangerine | 4.5 lb ai/A | 40 acres | 140 | 820 | 1100 | No Data | No Data | 3600 |
| | Kumquat | 4.5 lb ai/A | 40 acres | 140 | 820 | 1100 | No Data | No Data | 3600 |
| | Pine Seed Orchards, Christmas Tree Plantations | 3.2 lb ai/A | 40 acres | 200 | 1100 | 1500 | No Data | No Data | 5000 |
| | Nectarine, Peach | 3 lb ai/A | 40 acres | 210 | 1200 | 1600 | No Data | No Data | 5400 |
| | Chestnut, Pecans, Walnuts | 2.5 lb ai/A | 40 acres | 250 | 1500 | 1900 | No Data | No Data | 6400 |
| | Figs | 2 lb ai/A | 40 acres | 310 | 1800 | 2400 | No Data | No Data | 8000 |
| | Grapes (raisin, table, wine) | 1.88 lb ai/A | 40 acres | 330 | 2000 | 2500 | No Data | No Data | 8500 |
| | Cherry (Sweet and Tart) | 1.75 lb ai/A | 40 acres | 360 | 2100 | 2700 | No Data | No Data | 9200 |
| | Apricot | 1.5 lb ai/A | 40 acres | 420 | 2400 | 3100 | No Data | No Data | 11000 |
| | Grapefruit, Lemon, Lime, Orange, Tangelo, Tangerine | 1.5 lb ai/A | 40 acres | 420 | 2400 | 3100 | No Data | No Data | 11000 |
| | Pear | 1.25 lb ai/A | 40 acres | 500 | 2900 | 3800 | No Data | No Data | 13000 |

**Table I.1: Liquid Concentrate Formulations: Agricultural Non-ULV Applications Dermal Risks**
**Summary of Malathion Occupational Handler Short- and Intermediate-Term Dermal Risks**

| Exposure Scenario | Crop | App. Rate[c] (lb ai/A or /Gal) | Amount Handled Per Day[d] (A or Gal) | Level of Personal Protective Equipment for Dermal Exposures Dermal MOE[a] – LOC[b] = 1000 | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | | | Baseline[e] | SL/GL[f] | DL/GL[g] | SL/GL/CRH | DL/GL/CRH[i] | Eng. Controls[j] |
| Mixing/Loading to Support Airblast Applications | FL ONLY: Lemon | 1.25 lb ai/A | 40 acres | 500 | 2900 | 3800 | No Data | No Data | 13000 |
| | Guava, Papaya | 1.25 lb ai/A | 40 acres | 500 | 2900 | 3800 | No Data | No Data | 13000 |
| | Blueberry (highbush) | 1.25 lb ai/A | 40 acres | 500 | 2900 | 3800 | No Data | No Data | 13000 |
| | Passion Fruit | 1 lb ai/A | 40 acres | 630 | 3700 | 4800 | No Data | No Data | 16000 |
| | Mango | 0.94 lb ai/A | 40 acres | 670 | 3900 | 5100 | No Data | No Data | 17000 |
| | Macadamia Nut | 0.94 lb ai/A | 40 acres | 670 | 3900 | 5100 | No Data | No Data | 17000 |
| | Hops | 0.63 lb ai/A | 40 acres | 1000 | 5800 | 7500 | No Data | No Data | 25000 |
| Mixing/Loading to Support Dip Applications | Grape Root | 0.019 lb ai /gal. | 100 gallons | 13000 | 78000 | 100000 | No Data | No Data | 340000 |
| **Applicators** | | | | | | | | | |
| Aerial Applications | CA ONLY: Grapefruit, Lemon, Lime, Orange, Tangelo, Tangerine | 7.5 lb ai/A | 350 acres | No Data | No Data | No Data | No Data | No Data | 1000 |
| | Avocado | 4.75 lb ai/A | 350 acres | No Data | No Data | No Data | No Data | No Data | 1600 |
| | Grapefruit, Lemon, Lime, Orange, Tangelo, Tangerine | 4.5 lb ai/A | 350 acres | No Data | No Data | No Data | No Data | No Data | 1700 |
| | Kumquat | 4.5 lb ai/A | 350 acres | No Data | No Data | No Data | No Data | No Data | 1700 |
| | Pine Seed Orchards, Christmas Tree Plantations | 3.2 lb ai/A | 1200 acres | No Data | No Data | No Data | No Data | No Data | 690 |
| | Nectarine, Peach | 3 lb ai/A | 350 acres | No Data | No Data | No Data | No Data | No Data | 2500 |
| | Cotton | 2.5 lb ai/A | 1200 acres | No Data | No Data | No Data | No Data | No Data | 880 |
| | Chestnut, Pecans, Walnuts | 2.5 lb ai/A | 350 acres | No Data | No Data | No Data | No Data | No Data | 3000 |
| | Strawberry | 2 lb ai/A | 350 acres | No Data | No Data | No Data | No Data | No Data | 3800 |
| | Figs | 2 lb ai/A | 350 acres | No Data | No Data | No Data | No Data | No Data | 3800 |
| | Spinach | 2 lb ai/A | 350 acres | No Data | No Data | No Data | No Data | No Data | 3800 |

**Table I.1: Liquid Concentrate Formulations: Agricultural Non-ULV Applications Dermal Risks**
**Summary of Malathion Occupational Handler Short- and Intermediate-Term Dermal Risks**

| Exposure Scenario | Crop | App. Rate[c] (lb ai/A or /Gal) | Amount Handled Per Day[d] (A or Gal) | Level of Personal Protective Equipment for Dermal Exposures Dermal MOE[a] – LOC[b] = 1000 | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | | | Baseline[e] | SL/GL[f] | DL/GL[g] | SL/GL/CRH | DL/GL/CRH[i] | Eng. Controls[j] |
| Aerial Applications | Pineapple | 2 lb ai/A | 350 acres | No Data | No Data | No Data | No Data | No Data | 3800 |
| | Blackberry, Boysenberry, Dewberry, Loganberry, Raspberry | 2 lb ai/A | 350 acres | No Data | No Data | No Data | No Data | No Data | 3800 |
| | Gooseberry | 2 lb ai/A | 350 acres | No Data | No Data | No Data | No Data | No Data | 3800 |
| | Lettuce, head and leaf | 1.88 lb ai/A | 350 acres | No Data | No Data | No Data | No Data | No Data | 4000 |
| | Grapes (raisin, table, wine) | 1.88 lb ai/A | 350 acres | No Data | No Data | No Data | No Data | No Data | 4000 |
| | Cherry (Sweet and Tart) | 1.75 lb ai/A | 350 acres | No Data | No Data | No Data | No Data | No Data | 4300 |
| | Chayote Fruit, Cucumber, Summer Squash | 1.75 lb ai/A | 350 acres | No Data | No Data | No Data | No Data | No Data | 4300 |
| | Eggplant, Oriental Eggplant, Pepper, Tomato, Tomatillo | 1.56 lb ai/A | 350 acres | No Data | No Data | No Data | No Data | No Data | 4800 |
| | Chayote Root, Garlic, Leeks, Onion, Potatoes, Shallot, Sweet Potatoes, Yams | 1.56 lb ai/A | 350 acres | No Data | No Data | No Data | No Data | No Data | 4800 |
| | Apricot | 1.5 lb ai/A | 350 acres | No Data | No Data | No Data | No Data | No Data | 5100 |
| | Grapefruit, Lemon, Lime, Orange, Tangelo, Tangerine | 1.5 lb ai/A | 350 acres | No Data | No Data | No Data | No Data | No Data | 5100 |
| | Watermelon | 1.5 lb ai/A | 350 acres | No Data | No Data | No Data | No Data | No Data | 5100 |
| | Celery, Parsley | 1.5 lb ai/A | 350 acres | No Data | No Data | No Data | No Data | No Data | 5100 |
| | Barley, Rice, Wild Rice | 1.25 lb ai/A | 1200 acres | No Data | No Data | No Data | No Data | No Data | 1800 |
| | Grass - Forage and Hay | 1.25 lb ai/A | 1200 acres | No Data | No Data | No Data | No Data | No Data | 1800 |
| | Alfalfa, Birdsfoot Trefoil, Clover | 1.25 lb ai/A | 1200 acres | No Data | No Data | No Data | No Data | No Data | 1800 |
| | Blueberry, lowbush | 1.25 lb ai/A | 350 acres | No Data | No Data | No Data | No Data | No Data | 6100 |
| | Lespedeza, Vetch | 1.25 lb ai/A | 350 acres | No Data | No Data | No Data | No Data | No Data | 6100 |
| | Bermuda Grass | 1.25 lb ai/A | 350 acres | No Data | No Data | No Data | No Data | No Data | 6100 |
| | Pear | 1.25 lb ai/A | 350 acres | No Data | No Data | No Data | No Data | No Data | 6100 |

**Table I.1: Liquid Concentrate Formulations: Agricultural Non-ULV Applications Dermal Risks**
**Summary of Malathion Occupational Handler Short- and Intermediate-Term Dermal Risks**

| Exposure Scenario | Crop | App. Rate[c] (lb ai/A or /Gal) | Amount Handled Per Day[d] (A or Gal) | Level of Personal Protective Equipment for Dermal Exposures Dermal MOE[a] – LOC[b] = 1000 | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | | | Baseline[e] | SL/GL[f] | DL/GL[g] | SL/GL/CRH | DL/GL/CRH[i] | Eng. Controls[j] |
| Aerial Applications | FL ONLY: Lemon | 1.25 lb ai/A | 350 acres | No Data | No Data | No Data | No Data | No Data | 6100 |
| | Guava, Papaya | 1.25 lb ai/A | 350 acres | No Data | No Data | No Data | No Data | No Data | 6100 |
| | Broccoli, Broccoli Raab, Brussels Sprouts, Cabbage, Cauliflower, Chinese Broccoli, Dandelion | 1.25 lb ai/A | 350 acres | No Data | No Data | No Data | No Data | No Data | 6100 |
| | Endive. Kohlrabi, Chinese Greens, Watercress | 1.25 lb ai/A | 350 acres | No Data | No Data | No Data | No Data | No Data | 6100 |
| | Carrot, Garden Beets, Horseradish, Parsnip, Salsify, Turnip (greens & roots) | 1.25 lb ai/A | 350 acres | No Data | No Data | No Data | No Data | No Data | 6100 |
| | Asparagus | 1.25 lb ai/A | 350 acres | No Data | No Data | No Data | No Data | No Data | 6100 |
| | Blueberry (highbush), Currant | 1.25 lb ai/A | 350 acres | No Data | No Data | No Data | No Data | No Data | 6100 |
| | Okra | 1.2 lb ai/A | 350 acres | No Data | No Data | No Data | No Data | No Data | 6300 |
| | Oats, Rye, Spring Wheat, Winter Wheat | 1 lb ai/A | 1200 acres | No Data | No Data | No Data | No Data | No Data | 2200 |
| | Corn (field), Sorghum | 1 lb ai/A | 1200 acres | No Data | No Data | No Data | No Data | No Data | 2200 |
| | Peas - Succulent | 1 lb ai/A | 350 acres | No Data | No Data | No Data | No Data | No Data | 7500 |
| | Corn (pop and sweet) | 1 lb ai/A | 350 acres | No Data | No Data | No Data | No Data | No Data | 7500 |
| | Cantaloupe, Melon, Pumpkin, Winter Squash | 1 lb ai/A | 350 acres | No Data | No Data | No Data | No Data | No Data | 7500 |
| | Collard, Kale, Mustard Green, Swiss Chard | 1 lb ai/A | 350 acres | No Data | No Data | No Data | No Data | No Data | 7500 |
| | Peas - Succulent | 1 lb ai/A | 350 acres | No Data | No Data | No Data | No Data | No Data | 7500 |
| | Radish, Rutabaga | 1 lb ai/A | 350 acres | No Data | No Data | No Data | No Data | No Data | 7500 |
| | Passion Fruit | 1 lb ai/A | 350 acres | No Data | No Data | No Data | No Data | No Data | 7500 |
| | Mint | 0.94 lb ai/A | 350 acres | No Data | No Data | No Data | No Data | No Data | 8100 |

**Table I.1: Liquid Concentrate Formulations: Agricultural Non-ULV Applications Dermal Risks**
**Summary of Malathion Occupational Handler Short- and Intermediate-Term Dermal Risks**

| Exposure Scenario | Crop | App. Rate[c] (lb ai/A or /Gal) | Amount Handled Per Day[d] (A or Gal) | Level of Personal Protective Equipment for Dermal Exposures Dermal MOE[a] – LOC[b] = 1000 | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | | | Baseline[e] | SL/GL[f] | DL/GL[g] | SL/GL/CRH | DL/GL/CRH[i] | Eng. Controls[j] |
| Aerial Applications | Mango | 0.94 lb ai/A | 350 acres | No Data | No Data | No Data | No Data | No Data | 8100 |
| | Macadamia Nut | 0.94 lb ai/A | 350 acres | No Data | No Data | No Data | No Data | No Data | 8100 |
| | Hops | 0.63 lb ai/A | 350 acres | No Data | No Data | No Data | No Data | No Data | 12000 |
| | Flax | 0.5 lb ai/A | 1200 acres | No Data | No Data | No Data | No Data | No Data | 4400 |
| | Flowers and Foliage Grown for Cutting | 0.25 lb ai/A | 60 acres | No Data | No Data | No Data | No Data | No Data | 180000 |
| | Flowers, Shrubs, Flowering Plants, Nursery Stock, Woody Plants, Shade Trees (nursery grown) | 0.25 lb ai/A | 60 acres | No Data | No Data | No Data | No Data | No Data | 180000 |
| | Flowers, Shrubs, Flowering Plants, Nursery Stock, Woody Plants, Shade Trees (field grown) | 0.25 lb ai/A | 40 acres | No Data | No Data | No Data | No Data | No Data | 270000 |
| Groundboom Applications | Cotton | 2.5 lb ai/A | 200 acres | 140 | 680 | 880 | No Data | No Data | 2200 |
| | Strawberry | 2 lb ai/A | 80 acres | 440 | 2100 | 2700 | No Data | No Data | 6800 |
| | Spinach | 2 lb ai/A | 80 acres | 440 | 2100 | 2700 | No Data | No Data | 6800 |
| | Pineapple | 2 lb ai/A | 80 acres | 440 | 2100 | 2700 | No Data | No Data | 6800 |
| | Blackberry, Boysenberry, Dewberry, Loganberry, Raspberry | 2 lb ai/A | 80 acres | 440 | 2100 | 2700 | No Data | No Data | 6800 |
| | Gooseberry | 2 lb ai/A | 80 acres | 440 | 2100 | 2700 | No Data | No Data | 6800 |
| | Lettuce, head and leaf | 1.88 lb ai/A | 80 acres | 470 | 2300 | 2900 | No Data | No Data | 7200 |
| | Grapes (raisin, table, wine) | 1.88 lb ai/A | 80 acres | 470 | 2300 | 2900 | No Data | No Data | 7200 |
| | Chayote Fruit, Cucumber, Summer Squash | 1.75 lb ai/A | 80 acres | 500 | 2500 | 3100 | No Data | No Data | 7800 |

**Table I.1: Liquid Concentrate Formulations: Agricultural Non-ULV Applications Dermal Risks**
**Summary of Malathion Occupational Handler Short- and Intermediate-Term Dermal Risks**

| Exposure Scenario | Crop | App. Rate[c] (lb ai/A or /Gal) | Amount Handled Per Day[d] (A or Gal) | Level of Personal Protective Equipment for Dermal Exposures Dermal MOE[a] – LOC[b] = 1000 | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | | | Baseline[e] | SL/GL[f] | DL/GL[g] | SL/GL/CRH | DL/GL/CRH[i] | Eng. Controls[j] |
| Groundboom Applications | Eggplant, Oriental Eggplant, Pepper, Tomato, Tomatillo | 1.56 lb ai/A | 80 acres | 560 | 2700 | 3500 | No Data | No Data | 8700 |
| | Chayote Root, Garlic, Leeks, Onion, Potatoes, Shallot, Sweet Potatoes, Yams | 1.56 lb ai/A | 80 acres | 560 | 2700 | 3500 | No Data | No Data | 8700 |
| | Watermelon | 1.5 lb ai/A | 80 acres | 580 | 2900 | 3700 | No Data | No Data | 9000 |
| | Celery, Parsley | 1.5 lb ai/A | 80 acres | 580 | 2900 | 3700 | No Data | No Data | 9000 |
| | Barley, Rice, Wild Rice | 1.25 lb ai/A | 200 acres | 280 | 1400 | 1800 | No Data | No Data | 4300 |
| | Grass - Forage and Hay | 1.25 lb ai/A | 200 acres | 280 | 1400 | 1800 | No Data | No Data | 4300 |
| | Alfalfa, Birdsfoot Trefoil, Clover | 1.25 lb ai/A | 200 acres | 280 | 1400 | 1800 | No Data | No Data | 4300 |
| | Blueberry (lowbush) | 1.25 lb ai/A | 80 acres | 700 | 3400 | 4400 | No Data | No Data | 11000 |
| | Lespedeza, Vetch | 1.25 lb ai/A | 80 acres | 700 | 3400 | 4400 | No Data | No Data | 11000 |
| | Bermuda Grass | 1.25 lb ai/A | 80 acres | 700 | 3400 | 4400 | No Data | No Data | 11000 |
| | Broccoli, Broccoli Raab, Brussels Sprouts, Cabbage, Cauliflower, Chinese Broccoli, Dandelion | 1.25 lb ai/A | 80 acres | 700 | 3400 | 4400 | No Data | No Data | 11000 |
| | Endive. Kohlrabi, Chinese Greens, Watercress | 1.25 lb ai/A | 80 acres | 700 | 3400 | 4400 | No Data | No Data | 11000 |
| | Carrot, Garden Beets, Horseradish, Parsnip, Salsify, Turnip (greens & roots) | 1.25 lb ai/A | 80 acres | 700 | 3400 | 4400 | No Data | No Data | 11000 |
| | Asparagus | 1.25 lb ai/A | 80 acres | 700 | 3400 | 4400 | No Data | No Data | 11000 |
| | Blueberry (highbush), Currant | 1.25 lb ai/A | 80 acres | 700 | 3400 | 4400 | No Data | No Data | 11000 |
| | Okra | 1.2 lb ai/A | 80 acres | 730 | 3600 | 4600 | No Data | No Data | 11000 |

**Table I.1: Liquid Concentrate Formulations: Agricultural Non-ULV Applications Dermal Risks**
**Summary of Malathion Occupational Handler Short- and Intermediate-Term Dermal Risks**

| Exposure Scenario | Crop | App. Rate[c] (lb ai/A or /Gal) | Amount Handled Per Day[d] (A or Gal) | Level of Personal Protective Equipment for Dermal Exposures Dermal MOE[a] – LOC[b] = 1000 | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | | | Baseline[e] | SL/GL[f] | DL/GL[g] | SL/GL/CRH | DL/GL/CRH[i] | Eng. Controls[j] |
| Groundboom Applications | Oats, Rye, Spring Wheat, Winter Wheat | 1 lb ai/A | 200 acres | 350 | 1700 | 2200 | No Data | No Data | 5400 |
| | Corn (field), Sorghum | 1 lb ai/A | 200 acres | 350 | 1700 | 2200 | No Data | No Data | 5400 |
| | Peas - Succulent | 1 lb ai/A | 80 acres | 880 | 4300 | 5500 | No Data | No Data | 14000 |
| | Corn (pop and sweet) | 1 lb ai/A | 80 acres | 880 | 4300 | 5500 | No Data | No Data | 14000 |
| | Cantaloupe, Melon, Pumpkin, Winter Squash | 1 lb ai/A | 80 acres | 880 | 4300 | 5500 | No Data | No Data | 14000 |
| | Collard, Kale, Mustard Green, Swiss Chard | 1 lb ai/A | 80 acres | 880 | 4300 | 5500 | No Data | No Data | 14000 |
| | Peas - Succulent | 1 lb ai/A | 80 acres | 880 | 4300 | 5500 | No Data | No Data | 14000 |
| | Radish, Rutabaga | 1 lb ai/A | 80 acres | 880 | 4300 | 5500 | No Data | No Data | 14000 |
| | Passion Fruit | 1 lb ai/A | 80 acres | 880 | 4300 | 5500 | No Data | No Data | 14000 |
| | Flowers and Foliage Grown for Cutting | 1 lb ai/A | 60 acres | 1200 | 5700 | 7300 | No Data | No Data | 18000 |
| | Flowers, Shrubs, Flowering Plants, Nursery Stock, Woody Plants, Shade Trees (nursery grown) | 1 lb ai/A | 60 acres | 1200 | 5700 | 7300 | No Data | No Data | 18000 |
| | Flowers, Shrubs, Flowering Plants, Nursery Stock, Woody Plants, Shade Trees (field grown) | 1 lb ai/A | 40 acres | 1800 | 8600 | 11000 | No Data | No Data | 27000 |
| | Mint | 0.94 lb ai/A | 80 acres | 930 | 4600 | 5800 | No Data | No Data | 14000 |
| | Hops | 0.63 lb ai/A | 80 acres | 1400 | 6800 | 8700 | No Data | No Data | 22000 |
| | Flax | 0.5 lb ai/A | 200 acres | 700 | 3400 | 4400 | No Data | No Data | 11000 |

**Table I.1: Liquid Concentrate Formulations: Agricultural Non-ULV Applications Dermal Risks**
**Summary of Malathion Occupational Handler Short- and Intermediate-Term Dermal Risks**

| Exposure Scenario | Crop | App. Rate[c] (lb ai/A or /Gal) | Amount Handled Per Day[d] (A or Gal) | Level of Personal Protective Equipment for Dermal Exposures Dermal MOE[a] – LOC[b] = 1000 | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | | | Baseline[e] | SL/GL[f] | DL/GL[g] | SL/GL/CRH | DL/GL/CRH[i] | Eng. Controls[j] |
| Airblast Applications | Flowers and Foliage Grown for Cutting | 10 lb ai/A | 20 acres | 16 | 17 | 19 | 130 | 200 | 1900 |
| | Flowers, Shrubs, Flowering Plants, Nursery Stock, Woody Plants, Shade Trees (nursery grown) | 10 lb ai/A | 20 acres | 16 | 17 | 19 | 130 | 200 | 1900 |
| | Flowers, Shrubs, Flowering Plants, Nursery Stock, Woody Plants, Shade Trees (field grown) | 10 lb ai/A | 10 acres | 31 | 35 | 37 | 260 | 390 | 3800 |
| | CA ONLY: Grapefruit, Lemon, Lime, Orange, Tangelo, Tangerine | 7.5 lb ai/A | 40 acres | 10 | 12 | 12 | 86 | 130 | 1300 |
| | Avocado | 4.75 lb ai/A | 40 acres | 16 | 18 | 20 | 130 | 210 | 2000 |
| | Grapefruit, Lemon, Lime, Orange, Tangelo, Tangerine | 4.5 lb ai/A | 40 acres | 17 | 19 | 21 | 140 | 220 | 2100 |
| | Kumquat | 4.5 lb ai/A | 40 acres | 17 | 19 | 21 | 140 | 220 | 2100 |
| | Pine Seed Orchards, Christmas Tree Plantations | 3.2 lb ai/A | 40 acres | 24 | 27 | 29 | 200 | 310 | 3000 |
| Airblast Applications | Nectarine, Peach | 3 lb ai/A | 40 acres | 26 | 29 | 31 | 210 | 330 | 3100 |
| | Chestnut, Pecans, Walnuts | 2.5 lb ai/A | 40 acres | 31 | 35 | 37 | 260 | 390 | 3800 |
| | Figs | 2 lb ai/A | 40 acres | 39 | 43 | 47 | 320 | 490 | 4700 |
| | Grapes (raisin, table, wine) | 1.88 lb ai/A | 40 acres | 41 | 46 | 50 | 340 | 520 | 5000 |
| | Cherry (Sweet and Tart) | 1.75 lb ai/A | 40 acres | 44 | 50 | 53 | 370 | 560 | 5400 |
| | Apricot | 1.5 lb ai/A | 40 acres | 52 | 58 | 62 | 430 | 650 | 6300 |

**Table I.1: Liquid Concentrate Formulations: Agricultural Non-ULV Applications Dermal Risks**
**Summary of Malathion Occupational Handler Short- and Intermediate-Term Dermal Risks**

| Exposure Scenario | Crop | App. Rate[c] (lb ai/A or /Gal) | Amount Handled Per Day[d] (A or Gal) | Level of Personal Protective Equipment for Dermal Exposures Dermal MOE[a] – LOC[b] = 1000 | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | | | Baseline[e] | SL/GL[f] | DL/GL[g] | SL/GL/CRH | DL/GL/CRH[i] | Eng. Controls[j] |
| | Grapefruit, Lemon, Lime, Orange, Tangelo, Tangerine | 1.5 lb ai/A | 40 acres | 52 | 58 | 62 | 430 | 650 | 6300 |
| | Pear | 1.25 lb ai/A | 40 acres | 63 | 70 | 75 | 510 | 780 | 7500 |
| | FL ONLY: Lemon | 1.25 lb ai/A | 40 acres | 63 | 70 | 75 | 510 | 780 | 7500 |
| | Guava, Papaya | 1.25 lb ai/A | 40 acres | 63 | 70 | 75 | 510 | 780 | 7500 |
| | Blueberries (highbush) | 1.25 lb ai/A | 40 acres | 63 | 70 | 75 | 510 | 780 | 7500 |
| | Passion Fruit | 1 lb ai/A | 40 acres | 78 | 87 | 93 | 640 | 980 | 9500 |
| | Mango | 0.94 lb ai/A | 40 acres | 83 | 92 | 99 | 680 | 1000 | 10000 |
| | Macadamia Nut | 0.94 lb ai/A | 40 acres | 83 | 92 | 99 | 680 | 1000 | 10000 |
| | Hops | 0.63 lb ai/A | 40 acres | 120 | 140 | 150 | 1000 | 1600 | 15000 |
| **Flaggers** | | | | | | | | | |
| Flagging to Support Aerial Applications | CA ONLY: Grapefruit, Lemon, Lime, Orange, Tangelo, Tangerine | 7.5 lb ai/A | 350 acres | 190 | 180 | 200 | No Data | No Data | No Data |
| | Avocado | 4.75 lb ai/A | 350 acres | 300 | 280 | 310 | No Data | No Data | No Data |
| | Grapefruit, Lemon, Lime, Orange, Tangelo, Tangerine | 4.5 lb ai/A | 350 acres | 320 | 290 | 330 | No Data | No Data | No Data |
| | Kumquat | 4.5 lb ai/A | 350 acres | 320 | 290 | 330 | No Data | No Data | No Data |
| | Pine Seed Orchards, Christmas Tree Plantations | 3.2 lb ai/A | 350 acres | 450 | 410 | 470 | No Data | No Data | No Data |
| | Nectarine, Peach | 3 lb ai/A | 350 acres | 480 | 440 | 500 | No Data | No Data | No Data |
| | Cotton | 2.5 lb ai/A | 350 acres | 570 | 530 | 600 | No Data | No Data | No Data |
| | Chestnut, Pecans, Walnuts | 2.5 lb ai/A | 350 acres | 570 | 530 | 600 | No Data | No Data | No Data |
| | Strawberry | 2 lb ai/A | 350 acres | 710 | 660 | 740 | No Data | No Data | No Data |

**Table I.1: Liquid Concentrate Formulations: Agricultural Non-ULV Applications Dermal Risks**
**Summary of Malathion Occupational Handler Short- and Intermediate-Term Dermal Risks**

| Exposure Scenario | Crop | App. Rate[c] (lb ai/A or /Gal) | Amount Handled Per Day[d] (A or Gal) | Level of Personal Protective Equipment for Dermal Exposures Dermal MOE[a] – LOC[b] = 1000 | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | | | Baseline[e] | SL/GL[f] | DL/GL[g] | SL/GL/CRH | DL/GL/CRH[i] | Eng. Controls[j] |
| Flagging to Support Aerial Applications | Figs | 2 lb ai/A | 350 acres | 710 | 660 | 740 | No Data | No Data | No Data |
| | Spinach | 2 lb ai/A | 350 acres | 710 | 660 | 740 | No Data | No Data | No Data |
| | Pineapple | 2 lb ai/A | 350 acres | 710 | 660 | 740 | No Data | No Data | No Data |
| | Blackberry, Boysenberry, Dewberry, Loganberry, Raspberry | 2 lb ai/A | 350 acres | 710 | 660 | 740 | No Data | No Data | No Data |
| | Gooseberry | 2 lb ai/A | 350 acres | 710 | 660 | 740 | No Data | No Data | No Data |
| | Lettuce, head and leaf | 1.88 lb ai/A | 350 acres | 760 | 700 | 790 | No Data | No Data | No Data |
| | Grapes (raisin, table, wine) | 1.88 lb ai/A | 350 acres | 760 | 700 | 790 | No Data | No Data | No Data |
| | Cherry (Sweet and Tart) | 1.75 lb ai/A | 350 acres | 820 | 750 | 850 | No Data | No Data | No Data |
| | Chayote Fruit, Cucumber, Summer Squash | 1.75 lb ai/A | 350 acres | 820 | 750 | 850 | No Data | No Data | No Data |
| | Eggplant, Oriental Eggplant, Pepper, Tomato, Tomatillo | 1.56 lb ai/A | 350 acres | 920 | 840 | 950 | No Data | No Data | No Data |
| | Chayote Root, Garlic, Leeks, Onion, Potatoes, Shallot, Sweet Potatoes, Yams | 1.56 lb ai/A | 350 acres | 920 | 840 | 950 | No Data | No Data | No Data |
| | Apricot | 1.5 lb ai/A | 350 acres | 950 | 880 | 990 | No Data | No Data | No Data |
| | Grapefruit, Lemon, Lime, Orange, Tangelo, Tangerine | 1.5 lb ai/A | 350 acres | 950 | 880 | 990 | No Data | No Data | No Data |
| | Watermelon | 1.5 lb ai/A | 350 acres | 950 | 880 | 990 | No Data | No Data | No Data |
| | Celery, Parsley | 1.5 lb ai/A | 350 acres | 950 | 880 | 990 | No Data | No Data | No Data |
| | Blueberry, lowbush | 1.25 lb ai/A | 350 acres | 1100 | 1100 | 1200 | No Data | No Data | No Data |
| | Barley, Rice, Wild Rice | 1.25 lb ai/A | 350 acres | 1100 | 1100 | 1200 | No Data | No Data | No Data |
| | Grass - Forage and Hay | 1.25 lb ai/A | 350 acres | 1100 | 1100 | 1200 | No Data | No Data | No Data |
| | Alfalfa, Birdsfoot Trefoil, Clover | 1.25 lb ai/A | 350 acres | 1100 | 1100 | 1200 | No Data | No Data | No Data |
| | Lespedeza, Vetch | 1.25 lb ai/A | 350 acres | 1100 | 1100 | 1200 | No Data | No Data | No Data |
| | Bermuda Grass | 1.25 lb ai/A | 350 acres | 1100 | 1100 | 1200 | No Data | No Data | No Data |

**Table I.1: Liquid Concentrate Formulations: Agricultural Non-ULV Applications Dermal Risks**
**Summary of Malathion Occupational Handler Short- and Intermediate-Term Dermal Risks**

| Exposure Scenario | Crop | App. Rate[c] (lb ai/A or /Gal) | Amount Handled Per Day[d] (A or Gal) | Level of Personal Protective Equipment for Dermal Exposures Dermal MOE[a] – LOC[b] = 1000 | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | | | Baseline[e] | SL/GL[f] | DL/GL[g] | SL/GL/CRH | DL/GL/CRH[i] | Eng. Controls[j] |
| Flagging to Support Aerial Applications | Pear | 1.25 lb ai/A | 350 acres | 1100 | 1100 | 1200 | No Data | No Data | No Data |
| | FL ONLY: Lemon | 1.25 lb ai/A | 350 acres | 1100 | 1100 | 1200 | No Data | No Data | No Data |
| | Guava, Papaya | 1.25 lb ai/A | 350 acres | 1100 | 1100 | 1200 | No Data | No Data | No Data |
| | Broccoli, Broccoli Raab, Brussels Sprouts, Cabbage, Cauliflower, Chinese Broccoli, Dandelion | 1.25 lb ai/A | 350 acres | 1100 | 1100 | 1200 | No Data | No Data | No Data |
| | Endive. Kohlrabi, Chinese Greens, Watercress | 1.25 lb ai/A | 350 acres | 1100 | 1100 | 1200 | No Data | No Data | No Data |
| | Carrot, Garden Beets, Horseradish, Parsnip, Salsify, Turnip (greens & roots) | 1.25 lb ai/A | 350 acres | 1100 | 1100 | 1200 | No Data | No Data | No Data |
| | Asparagus | 1.25 lb ai/A | 350 acres | 1100 | 1100 | 1200 | No Data | No Data | No Data |
| | Blueberry (highbush), Currant | 1.25 lb ai/A | 350 acres | 1100 | 1100 | 1200 | No Data | No Data | No Data |
| | Okra | 1.2 lb ai/A | 350 acres | 1200 | 1100 | 1200 | No Data | No Data | No Data |
| | Oats, Rye, Spring Wheat, Winter Wheat | 1 lb ai/A | 350 acres | 1400 | 1300 | 1500 | No Data | No Data | No Data |
| | Peas - Succulent | 1 lb ai/A | 350 acres | 1400 | 1300 | 1500 | No Data | No Data | No Data |
| | Corn (field), Sorghum | 1 lb ai/A | 350 acres | 1400 | 1300 | 1500 | No Data | No Data | No Data |
| | Corn (pop and sweet) | 1 lb ai/A | 350 acres | 1400 | 1300 | 1500 | No Data | No Data | No Data |
| | Cantaloupe, Melon, Pumpkin, Winter Squash | 1 lb ai/A | 350 acres | 1400 | 1300 | 1500 | No Data | No Data | No Data |
| | Collard, Kale, Mustard Green, Swiss Chard | 1 lb ai/A | 350 acres | 1400 | 1300 | 1500 | No Data | No Data | No Data |

**Table I.1: Liquid Concentrate Formulations: Agricultural Non-ULV Applications Dermal Risks**
**Summary of Malathion Occupational Handler Short- and Intermediate-Term Dermal Risks**

| Exposure Scenario | Crop | App. Rate[c] (lb ai/A or /Gal) | Amount Handled Per Day[d] (A or Gal) | Level of Personal Protective Equipment for Dermal Exposures Dermal MOE[a] – LOC[b] = 1000 | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | | | Baseline[e] | SL/GL[f] | DL/GL[g] | SL/GL/CRH | DL/GL/CRH[i] | Eng. Controls[j] |
| | Peas - Succulent | 1 lb ai/A | 350 acres | 1400 | 1300 | 1500 | No Data | No Data | No Data |
| | Radish, Rutabaga | 1 lb ai/A | 350 acres | 1400 | 1300 | 1500 | No Data | No Data | No Data |
| | Passion Fruit | 1 lb ai/A | 350 acres | 1400 | 1300 | 1500 | No Data | No Data | No Data |
| | Mint | 0.94 lb ai/A | 350 acres | 1500 | 1400 | 1600 | No Data | No Data | No Data |
| | Mango | 0.94 lb ai/A | 350 acres | 1500 | 1400 | 1600 | No Data | No Data | No Data |
| | Macadamia Nut | 0.94 lb ai/A | 350 acres | 1500 | 1400 | 1600 | No Data | No Data | No Data |
| | Hops | 0.63 lb ai/A | 350 acres | 2300 | 2100 | 2400 | No Data | No Data | No Data |
| | Flax | 0.5 lb ai/A | 350 acres | 2900 | 2600 | 3000 | No Data | No Data | No Data |
| | Flowers and Foliage Grown for Cutting | 0.25 lb ai/A | 60 acres | 33000 | 31000 | 35000 | No Data | No Data | No Data |
| | Flowers, Shrubs, Flowering Plants, Nursery Stock, Woody Plants, Shade Trees (nursery grown) | 0.25 lb ai/A | 60 acres | 33000 | 31000 | 35000 | No Data | No Data | No Data |
| Flagging to Support Aerial Applications | Flowers, Shrubs, Flowering Plants, Nursery Stock, Woody Plants, Shade Trees (field grown) | 0.25 lb ai/A | 40 acres | 50000 | 46000 | 52000 | No Data | No Data | No Data |
| **Mixer/Loader/Applicators** | | | | | | | | | |
| Mixing/Loading/ Applying with | Pine Seed Orchards, Christmas Tree Plantations | Pine Seed Orchards, Christmas | 3.2 lb ai/A | 5 acres | 5.9 | 11 | 20 | No Data | No Data |

**Table I.1: Liquid Concentrate Formulations: Agricultural Non-ULV Applications Dermal Risks**
**Summary of Malathion Occupational Handler Short- and Intermediate-Term Dermal Risks**

| Exposure Scenario | Crop | App. Rate[c] (lb ai/A or /Gal) | Amount Handled Per Day[d] (A or Gal) | Level of Personal Protective Equipment for Dermal Exposures Dermal MOE[a] – LOC[b] = 1000 | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | | | Baseline[e] | SL/GL[f] | DL/GL[g] | SL/GL/CRH | DL/GL/CRH[i] | Eng. Controls[j] |
| Backpack Equipment | | Tree Plantations | | | | | | | |
| | Mushroom | Mushroom | 1.7 lb ai/A | 0.37 acres | 150 | 290 | 520 | No Data | No Data |
| | Flowers and Foliage Grown for Cutting | Flowers and Foliage Grown for Cutting | 0.025 lb ai /gal. | 40 gallons | 95 | 180 | 330 | No Data | No Data |
| | Flowers, Shrubs, Flowering Plants, Nursery Stock, Woody Plants, Shade Trees – foliar directed | Flowers, Shrubs, Flowering Plants, Nursery Stock, Woody Plants, Shade Trees – foliar directed | 0.025 lb ai /gal. | 40 gallons | 95 | 180 | 330 | No Data | No Data |
| | Flowers, Shrubs, Flowering Plants, Nursery Stock, Woody Plants, Shade Trees – ground directed | 0.025 lb ai /gal. | 40 gallons | 670 | 670 | 1300 | No Data | No Data | No Data |
| Mixing/Loading/ Applying with Handheld Fogger Equipment | Mushroom | 1.7 lb ai/A | 0.37 acres | No Data | No Data | No Data | No Data | No Data | No Data |

**Table I.1: Liquid Concentrate Formulations: Agricultural Non-ULV Applications Dermal Risks**
**Summary of Malathion Occupational Handler Short- and Intermediate-Term Dermal Risks**

| Exposure Scenario | Crop | App. Rate[c] (lb ai/A or /Gal) | Amount Handled Per Day[d] (A or Gal) | Level of Personal Protective Equipment for Dermal Exposures Dermal MOE[a] – LOC[b] = 1000 | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | | | Baseline[e] | SL/GL[f] | DL/GL[g] | SL/GL/CRH | DL/GL/CRH[i] | Eng. Controls[j] |
| Mixing/Loading/ Applying with Manually-Pressurized Handgun Equipment | Pine Seed Orchards, Christmas Tree Plantations | 3.2 lb ai/A | 5 acres | 3.4 | 800 | 950 | No Data | No Data | No Data |
| | Mushroom | 1.7 lb ai/A | 0.37 acres | 88 | 20000 | 24000 | No Data | No Data | No Data |
| | Flowers and Foliage Grown for Cutting | 0.025 lb ai /gal. | 40 gallons | 55 | 13000 | 15000 | No Data | No Data | No Data |
| | Flowers, Shrubs, Flowering Plants, Nursery Stock, Woody Plants, Shade Trees | 0.025 lb ai /gal. | 40 gallons | 55 | 13000 | 15000 | No Data | No Data | No Data |
| Mixing/Loading/ Applying with Mechanically-Pressurized Handgun Equipment | Pine Seed Orchards, Christmas Tree Plantations | 3.2 lb ai/A | 5 acres | 57 | 170 | 250 | No Data | No Data | No Data |
| | Mushroom | 1.7 lb ai/A | 0.37 acres | 2500 | 3500 | 5500 | No Data | No Data | No Data |
| | Flowers and Foliage Grown for Cutting | 0.025 lb ai /gal. | 1000 gallons | 37 | 110 | 160 | No Data | No Data | No Data |
| | Flowers, Shrubs, Flowering Plants, Nursery Stock, Woody Plants, Shade Trees (foliar or ground directed) | 0.025 lb ai /gal. | 1000 gallons | 37 | 110 | 160 | No Data | No Data | No Data |

a MOE = margin of exposure = Dermal Point of Departure (80 acres mg/kg/day) / Dermal Dose (mg/kg/day); where dermal dose = daily unit exposure (mg/lb ai) x application rate x amount handled per day x 100% dermal absorption (route-specific PoD) / bodyweight (69 kg average female adult).
b LOC = level of concern = 1000.
c Application rates are the maximum application rates determined from EPA registered labels for malathion. Listed as pounds active ingredient per acre, unless pounds per gallon are specified.
d Amount handled per day values are HED estimates of acres treated per day or gallons applied per day based on industry sources and HED estimates.
e Baseline = long-sleeve shirt, long pants, shoes, socks, and no gloves .
f SL/GL = long-sleeve shirt, long pants, shoes, socks, and chemical-resistant gloves.
g DL/GL = coveralls worn over long-sleeve shirt and long pants, chemical-resistant footwear, socks, and chemical-resistant gloves.
h SL/GL/CRH = long-sleeve shirt and long pants, shoes, socks, chemical-resistant gloves, and chemical-resistant headgear.

i DL/GL/CRH = coveralls worn over long-sleeve shirt, long pants, chemical-resistant footwear, socks, chemical-resistant gloves, and chemical-resistant headgear.

j Eng. Control = Engineering control including closed mixing/loading system, enclosed cab, or enclosed cockpit.

**Table I.2: Liquid Concentrate Formulations: Agricultural Non-ULV Applications Inhalation Risks**
**Summary of Malathion Occupational Handler Short / Intermediate-Term Inhalation Risks**

| Exposure Scenario | Crop | App. Rate[c] (lb ai/A or lb ai/Gal) | Amount Handled Per Day[d] (A or Gal) | Level of Personal Protective Equipment for Inhalation Exposures Inhalation MOE[a] – LOC[b] = 3000 | | | |
|---|---|---|---|---|---|---|---|
| | | | | Baseline No-R[e] | PF5-R[f] | PF10-R[g] | Eng. Controls[h] |
| **Mixer/Loaders** | | | | | | | |
| Mixing/Loading to Support Aerial Applications | CA ONLY: Grapefruit, Lemon, Lime, Orange, Tangelo, Tangerine | 7.5 lb ai/acre | 350 acres | 450 | 2200 | 4500 | 1200 |
| | Avocado | 4.75 lb ai/acre | 350 acres | 710 | 3500 | 7100 | 1900 |
| | Grapefruit, Lemon, Lime, Orange, Tangelo, Tangerine | 4.5 lb ai/acre | 350 acres | 750 | 3700 | 7500 | 2000 |
| | Kumquat | 4.5 lb ai/acre | 350 acres | 750 | 3700 | 7500 | 2000 |
| | Pine Seed Orchards, Christmas Tree Plantations | 3.2 lb ai/acre | 1200 acres | 310 | 1500 | 3100 | 810 |
| | Nectarine, Peach | 3 lb ai/acre | 350 acres | 1100 | 5600 | 11000 | 3000 |
| | Cotton | 2.5 lb ai/acre | 1200 acres | 390 | 2000 | 3900 | 1000 |
| | Chestnut, Pecans, Walnuts | 2.5 lb ai/acre | 350 acres | 1300 | 6700 | 13000 | 3600 |
| | Strawberry | 2 lb ai/acre | 350 acres | 1700 | 8400 | 17000 | 4400 |
| | Figs | 2 lb ai/acre | 350 acres | 1700 | 8400 | 17000 | 4400 |
| | Spinach | 2 lb ai/acre | 350 acres | 1700 | 8400 | 17000 | 4400 |
| | Pineapple | 2 lb ai/acre | 350 acres | 1700 | 8400 | 17000 | 4400 |
| | Blackberry, Boysenberry, Dewberry, Loganberry, Raspberry | 2 lb ai/acre | 350 acres | 1700 | 8400 | 17000 | 4400 |
| | Gooseberry | 2 lb ai/acre | 350 acres | 1700 | 8400 | 17000 | 4400 |
| | Lettuce, head and leaf | 1.88 lb ai/acre | 350 acres | 1800 | 9000 | 18000 | 4700 |
| | Grapes (raisin, table, wine) | 1.88 lb ai/acre | 350 acres | 1800 | 9000 | 18000 | 4700 |
| | Cherry (Sweet and Tart) | 1.75 lb ai/acre | 350 acres | 1900 | 9600 | 19000 | 5100 |
| | Chayote Fruit, Cucumber, Summer Squash | 1.75 lb ai/acre | 350 acres | 1900 | 9600 | 19000 | 5100 |
| | Eggplant, Oriental Eggplant, Pepper, Tomato, Tomatillo | 1.56 lb ai/acre | 350 acres | 2100 | 11000 | 21000 | 5700 |
| | Chayote Root, Garlic, Leeks, Onion, Potatoes, Shallot, Sweet Potatoes, Yams | 1.56 lb ai/acre | 350 acres | 2100 | 11000 | 21000 | 5700 |

**Table I.2: Liquid Concentrate Formulations: Agricultural Non-ULV Applications Inhalation Risks**
**Summary of Malathion Occupational Handler Short / Intermediate-Term Inhalation Risks**

| Exposure Scenario | Crop | App. Rate[c] (lb ai/A or lb ai/Gal) | Amount Handled Per Day[d] (A or Gal) | Level of Personal Protective Equipment for Inhalation Exposures Inhalation MOE[a] – LOC[b] = 3000 | | | |
|---|---|---|---|---|---|---|---|
| | | | | Baseline No-R[e] | PF5-R[f] | PF10-R[g] | Eng. Controls[h] |
| Mixing/Loading to Support Aerial Applications | Apricot | 1.5 lb ai/acre | 350 acres | 2200 | 11000 | 22000 | 5900 |
| | Grapefruit, Lemon, Lime, Orange, Tangelo, Tangerine | 1.5 lb ai/acre | 350 acres | 2200 | 11000 | 22000 | 5900 |
| | Watermelon | 1.5 lb ai/acre | 350 acres | 2200 | 11000 | 22000 | 5900 |
| | Celery, Parsley | 1.5 lb ai/acre | 350 acres | 2200 | 11000 | 22000 | 5900 |
| | Barley, Rice, Wild Rice | 1.25 lb ai/acre | 1200 acres | 780 | 3900 | 7800 | 2100 |
| | Grass - Forage and Hay | 1.25 lb ai/acre | 1200 acres | 780 | 3900 | 7800 | 2100 |
| | Alfalfa, Birdsfoot Trefoil, Clover | 1.25 lb ai/acre | 1200 acres | 780 | 3900 | 7800 | 2100 |
| | Blueberry (lowbush) | 1.25 lb ai/acre | 350 acres | 2700 | 13000 | 27000 | 7100 |
| | Lespedeza, Vetch | 1.25 lb ai/acre | 350 acres | 2700 | 13000 | 27000 | 7100 |
| | Bermuda Grass | 1.25 lb ai/acre | 350 acres | 2700 | 13000 | 27000 | 7100 |
| | Pear | 1.25 lb ai/acre | 350 acres | 2700 | 13000 | 27000 | 7100 |
| | FL ONLY: Lemon | 1.25 lb ai/acre | 350 acres | 2700 | 13000 | 27000 | 7100 |
| | Guava, Papaya | 1.25 lb ai/acre | 350 acres | 2700 | 13000 | 27000 | 7100 |
| | Broccoli, Broccoli Raab, Brussels Sprouts, Cabbage, Cauliflower, Chinese | 1.25 lb ai/acre | 350 acres | 2700 | 13000 | 27000 | 7100 |
| | Broccoli, Dandelion Endive. Kohlrabi, Chinese Greens, Watercress | 1.25 lb ai/acre | 350 acres | 2700 | 13000 | 27000 | 7100 |
| | Carrot, Garden Beets, Horseradish, Parsnip, Salsify, Turnip (greens & roots) | 1.25 lb ai/acre | 350 acres | 2700 | 13000 | 27000 | 7100 |
| | Asparagus | 1.25 lb ai/acre | 350 acres | 2700 | 13000 | 27000 | 7100 |
| | Blueberry (highbush), Currant | 1.25 lb ai/acre | 350 acres | 2700 | 13000 | 27000 | 7100 |
| | Okra | 1.2 lb ai/acre | 350 acres | 2800 | 14000 | 28000 | 7400 |
| | Oats, Rye, Spring Wheat, Winter Wheat | 1 lb ai/acre | 1200 acres | 980 | 4900 | 9800 | 2600 |
| | Corn (field), Sorghum | 1 lb ai/acre | 1200 acres | 980 | 4900 | 9800 | 2600 |
| | Peas - Succulent | 1 lb ai/acre | 350 acres | 3400 | 17000 | 34000 | 8900 |

**Table I.2: Liquid Concentrate Formulations: Agricultural Non-ULV Applications Inhalation Risks**
**Summary of Malathion Occupational Handler Short / Intermediate-Term Inhalation Risks**

| Exposure Scenario | Crop | App. Rate[c] (lb ai/A or lb ai/Gal) | Amount Handled Per Day[d] (A or Gal) | Level of Personal Protective Equipment for Inhalation Exposures Inhalation MOE[a] – LOC[b] = 3000 | | | |
|---|---|---|---|---|---|---|---|
| | | | | Baseline No-R[e] | PF5-R[f] | PF10-R[g] | Eng. Controls[h] |
| Mixing/Loading to Support Aerial Applications | Corn (pop and sweet) | 1 lb ai/acre | 350 acres | 3400 | 17000 | 34000 | 8900 |
| | Cantaloupe, Melon, Pumpkin, Winter Squash | 1 lb ai/acre | 350 acres | 3400 | 17000 | 34000 | 8900 |
| | Collard, Kale, Mustard Green, Swiss Chard | 1 lb ai/acre | 350 acres | 3400 | 17000 | 34000 | 8900 |
| | Peas - Succulent | 1 lb ai/acre | 350 acres | 3400 | 17000 | 34000 | 8900 |
| | Radish, Rutabaga | 1 lb ai/acre | 350 acres | 3400 | 17000 | 34000 | 8900 |
| | Passion Fruit | 1 lb ai/acre | 350 acres | 3400 | 17000 | 34000 | 8900 |
| | Mint | 0.94 lb ai/acre | 350 acres | 3600 | 18000 | 36000 | 9400 |
| | Mango | 0.94 lb ai/acre | 350 acres | 3600 | 18000 | 36000 | 9400 |
| | Macadamia Nut | 0.94 lb ai/acre | 350 acres | 3600 | 18000 | 36000 | 9400 |
| | Hops | 0.63 lb ai/acre | 350 acres | 5300 | 27000 | 53000 | 14000 |
| | Flax | 0.5 lb ai/acre | 1200 acres | 2000 | 9800 | 20000 | 5200 |
| | Flowers and Foliage Grown for Cutting | 0.25 lb ai/acre | 60 acres | 78000 | 390000 | 780000 | 210000 |
| | Flowers, Shrubs, Flowering Plants, Nursery Stock, Woody Plants, Shade Trees (nursery grown) | 0.25 lb ai/acre | 60 acres | 78000 | 390000 | 780000 | 210000 |
| | Flowers, Shrubs, Flowering Plants, Nursery Stock, Woody Plants, Shade Trees (field grown) | 0.25 lb ai/acre | 40 acres | 120000 | 590000 | 1200000 | 310000 |
| Mixing/Loading to Support Chemigation Applications | CA ONLY: Grapefruit, Lemon, Lime, Orange, Tangelo, Tangerine | 7.5 lb ai/acre | 350 acres | 450 | 2200 | 4500 | 1200 |
| | Avocado | 4.75 lb ai/acre | 350 acres | 710 | 3500 | 7100 | 1900 |
| | Grapefruit, Lemon, Lime, Orange, Tangelo, Tangerine | 4.5 lb ai/acre | 350 acres | 750 | 3700 | 7500 | 2000 |
| | Kumquat | 4.5 lb ai/acre | 350 acres | 750 | 3700 | 7500 | 2000 |
| | Pine Seed Orchards, Christmas Tree Plantations | 3.2 lb ai/acre | 350 acres | 1100 | 5300 | 11000 | 2800 |
| | Nectarine, Peach | 3 lb ai/acre | 350 acres | 1100 | 5600 | 11000 | 3000 |

**Table I.2: Liquid Concentrate Formulations: Agricultural Non-ULV Applications Inhalation Risks**
**Summary of Malathion Occupational Handler Short / Intermediate-Term Inhalation Risks**

| Exposure Scenario | Crop | App. Rate[c] (lb ai/A or lb ai/Gal) | Amount Handled Per Day[d] (A or Gal) | Level of Personal Protective Equipment for Inhalation Exposures Inhalation MOE[a] – LOC[b] = 3000 | | | |
|---|---|---|---|---|---|---|---|
| | | | | Baseline No-R[e] | PF5-R[f] | PF10-R[g] | Eng. Controls[h] |
| Mixing/Loading to Support Chemigation Applications | Cotton | 2.5 lb ai/acre | 350 acres | 1300 | 6700 | 13000 | 3600 |
| | Chestnut, Pecans, Walnuts | 2.5 lb ai/acre | 350 acres | 1300 | 6700 | 13000 | 3600 |
| | Strawberry | 2 lb ai/acre | 350 acres | 1700 | 8400 | 17000 | 4400 |
| | Figs | 2 lb ai/acre | 350 acres | 1700 | 8400 | 17000 | 4400 |
| | Spinach | 2 lb ai/acre | 350 acres | 1700 | 8400 | 17000 | 4400 |
| | Pineapple | 2 lb ai/acre | 350 acres | 1700 | 8400 | 17000 | 4400 |
| | Blackberry, Boysenberry, Dewberry, Loganberry, Raspberry | 2 lb ai/acre | 350 acres | 1700 | 8400 | 17000 | 4400 |
| | Gooseberry | 2 lb ai/acre | 350 acres | 1700 | 8400 | 17000 | 4400 |
| | Lettuce, head and leaf | 1.88 lb ai/acre | 350 acres | 1800 | 9000 | 18000 | 4700 |
| | Grapes (raisin, table, wine) | 1.88 lb ai/acre | 350 acres | 1800 | 9000 | 18000 | 4700 |
| | Cherry (Sweet and Tart) | 1.75 lb ai/acre | 350 acres | 1900 | 9600 | 19000 | 5100 |
| | Chayote Fruit, Cucumber, Summer Squash | 1.75 lb ai/acre | 350 acres | 1900 | 9600 | 19000 | 5100 |
| | Eggplant, Oriental Eggplant, Pepper, Tomato, Tomatillo | 1.56 lb ai/acre | 350 acres | 2100 | 11000 | 21000 | 5700 |
| | Chayote Root, Garlic, Leeks, Onion, Potatoes, Shallot, Sweet Potatoes, Yams | 1.56 lb ai/acre | 350 acres | 2100 | 11000 | 21000 | 5700 |
| | Apricot | 1.5 lb ai/acre | 350 acres | 2200 | 11000 | 22000 | 5900 |
| | Grapefruit, Lemon, Lime, Orange, Tangelo, Tangerine | 1.5 lb ai/acre | 350 acres | 2200 | 11000 | 22000 | 5900 |
| | Watermelon | 1.5 lb ai/acre | 350 acres | 2200 | 11000 | 22000 | 5900 |
| | Celery, Parsley | 1.5 lb ai/acre | 350 acres | 2200 | 11000 | 22000 | 5900 |
| | Alfalfa, Birdsfoot Trefoil, Clover | 1.25 lb ai/acre | 1200 acres | 780 | 3900 | 7800 | 2100 |
| | Blueberry (lowbush) | 1.25 lb ai/acre | 350 acres | 2700 | 13000 | 27000 | 7100 |
| | Barley, Rice, Wild Rice | 1.25 lb ai/acre | 350 acres | 2700 | 13000 | 27000 | 7100 |
| | Grass - Forage and Hay | 1.25 lb ai/acre | 350 acres | 2700 | 13000 | 27000 | 7100 |
| | Lespedeza, Vetch | 1.25 lb ai/acre | 350 acres | 2700 | 13000 | 27000 | 7100 |
| | Bermuda Grass | 1.25 lb ai/acre | 350 acres | 2700 | 13000 | 27000 | 7100 |

**Table I.2: Liquid Concentrate Formulations: Agricultural Non-ULV Applications Inhalation Risks**
**Summary of Malathion Occupational Handler Short / Intermediate-Term Inhalation Risks**

| Exposure Scenario | Crop | App. Rate[c] (lb ai/A or lb ai/Gal) | Amount Handled Per Day[d] (A or Gal) | Level of Personal Protective Equipment for Inhalation Exposures Inhalation MOE[a] – LOC[b] = 3000 | | | |
|---|---|---|---|---|---|---|---|
| | | | | Baseline No-R[e] | PF5-R[f] | PF10-R[g] | Eng. Controls[h] |
| Mixing/Loading to Support Chemigation Applications | Pear | 1.25 lb ai/acre | 350 acres | 2700 | 13000 | 27000 | 7100 |
| | FL ONLY: Lemon | 1.25 lb ai/acre | 350 acres | 2700 | 13000 | 27000 | 7100 |
| | Guava, Papaya | 1.25 lb ai/acre | 350 acres | 2700 | 13000 | 27000 | 7100 |
| | Broccoli, Broccoli Raab, Brussels Sprouts, Cabbage, Cauliflower, Chinese Broccoli, Dandelion | 1.25 lb ai/acre | 350 acres | 2700 | 13000 | 27000 | 7100 |
| | Endive. Kohlrabi, Chinese Greens, Watercress | 1.25 lb ai/acre | 350 acres | 2700 | 13000 | 27000 | 7100 |
| | Carrot, Garden Beets, Horseradish, Parsnip, Salsify, Turnip (greens & roots) | 1.25 lb ai/acre | 350 acres | 2700 | 13000 | 27000 | 7100 |
| | Asparagus | 1.25 lb ai/acre | 350 acres | 2700 | 13000 | 27000 | 7100 |
| | Blueberry (highbush), Currant | 1.25 lb ai/acre | 350 acres | 2700 | 13000 | 27000 | 7100 |
| | Okra | 1.2 lb ai/acre | 350 acres | 2800 | 14000 | 28000 | 7400 |
| | Oats, Rye, Spring Wheat, Winter Wheat | 1 lb ai/acre | 350 acres | 3400 | 17000 | 34000 | 8900 |
| | Peas - Succulent | 1 lb ai/acre | 350 acres | 3400 | 17000 | 34000 | 8900 |
| | Corn (field), Sorghum | 1 lb ai/acre | 350 acres | 3400 | 17000 | 34000 | 8900 |
| | Corn (pop and sweet) | 1 lb ai/acre | 350 acres | 3400 | 17000 | 34000 | 8900 |
| | Cantaloupe, Melon, Pumpkin, Winter Squash | 1 lb ai/acre | 350 acres | 3400 | 17000 | 34000 | 8900 |
| | Collard, Kale, Mustard Green, Swiss Chard | 1 lb ai/acre | 350 acres | 3400 | 17000 | 34000 | 8900 |
| | Peas - Succulent | 1 lb ai/acre | 350 acres | 3400 | 17000 | 34000 | 8900 |
| | Radish, Rutabaga | 1 lb ai/acre | 350 acres | 3400 | 17000 | 34000 | 8900 |
| | Passion Fruit | 1 lb ai/acre | 350 acres | 3400 | 17000 | 34000 | 8900 |
| | Flowers and Foliage Grown for Cutting | 1 lb ai/acre | 60 acres | 20000 | 98000 | 200000 | 52000 |
| | Flowers, Shrubs, Flowering Plants, Nursery Stock, Woody | 1 lb ai/acre | 60 acres | 20000 | 98000 | 200000 | 52000 |

**Table I.2: Liquid Concentrate Formulations: Agricultural Non-ULV Applications Inhalation Risks**
**Summary of Malathion Occupational Handler Short / Intermediate-Term Inhalation Risks**

| Exposure Scenario | Crop | App. Rate[c] (lb ai/A or lb ai/Gal) | Amount Handled Per Day[d] (A or Gal) | Level of Personal Protective Equipment for Inhalation Exposures Inhalation MOE[a] – LOC[b] = 3000 | | | |
|---|---|---|---|---|---|---|---|
| | | | | Baseline No-R[e] | PF5-R[f] | PF10-R[g] | Eng. Controls[h] |
| Mixing/Loading to Support Chemigation Applications | Plants, Shade Trees (nursery grown) Flowers, Shrubs, Flowering Plants, Nursery Stock, Woody Plants, Shade Trees (field grown) | 1 lb ai/acre | 40 acres | 29000 | 150000 | 290000 | 78000 |
| | Mint | 0.94 lb ai/acre | 350 acres | 3600 | 18000 | 36000 | 9400 |
| | Mango | 0.94 lb ai/acre | 350 acres | 3600 | 18000 | 36000 | 9400 |
| | Macadamia Nut | 0.94 lb ai/acre | 350 acres | 3600 | 18000 | 36000 | 9400 |
| | Hops | 0.63 lb ai/acre | 350 acres | 5300 | 27000 | 53000 | 14000 |
| | Flax | 0.5 lb ai/acre | 350 acres | 6700 | 34000 | 67000 | 18000 |
| Mixing/Loading to Support Groundboom Applications | Cotton | 2.5 lb ai/acre | 200 acres | 2400 | 12000 | 24000 | 6200 |
| | Strawberry | 2 lb ai/acre | 80 acres | 7400 | 37000 | 74000 | 19000 |
| | Spinach | 2 lb ai/acre | 80 acres | 7400 | 37000 | 74000 | 19000 |
| | Pineapple | 2 lb ai/acre | 80 acres | 7400 | 37000 | 74000 | 19000 |
| | Blackberry, Boysenberry, Dewberry, Loganberry, Raspberry | 2 lb ai/acre | 80 acres | 7400 | 37000 | 74000 | 19000 |
| | Gooseberry | 2 lb ai/acre | 80 acres | 7400 | 37000 | 74000 | 19000 |
| | Lettuce, head and leaf | 1.88 lb ai/acre | 80 acres | 7800 | 39000 | 78000 | 21000 |
| | Grapes (raisin, table, wine) | 1.88 lb ai/acre | 80 acres | 7800 | 39000 | 78000 | 21000 |
| | Chayote Fruit, Cucumber, Summer Squash | 1.75 lb ai/acre | 80 acres | 8400 | 42000 | 84000 | 22000 |
| | Eggplant, Oriental Eggplant, Pepper, Tomato, Tomatillo | 1.56 lb ai/acre | 80 acres | 9400 | 47000 | 94000 | 25000 |
| | Chayote Root, Garlic, Leeks, Onion, Potatoes, Shallot, Sweet Potatoes, Yams | 1.56 lb ai/acre | 80 acres | 9400 | 47000 | 94000 | 25000 |
| | Watermelon | 1.5 lb ai/acre | 80 acres | 9800 | 49000 | 98000 | 26000 |
| | Celery, Parsley | 1.5 lb ai/acre | 80 acres | 9800 | 49000 | 98000 | 26000 |
| | Barley, Rice, Wild Rice | 1.25 lb ai/acre | 200 acres | 4700 | 24000 | 47000 | 12000 |
| | Grass - Forage and Hay | 1.25 lb ai/acre | 200 acres | 4700 | 24000 | 47000 | 12000 |

**Table I.2: Liquid Concentrate Formulations: Agricultural Non-ULV Applications Inhalation Risks**
**Summary of Malathion Occupational Handler Short / Intermediate-Term Inhalation Risks**

| Exposure Scenario | Crop | App. Rate[c] (lb ai/A or lb ai/Gal) | Amount Handled Per Day[d] (A or Gal) | Level of Personal Protective Equipment for Inhalation Exposures Inhalation MOE[a] – LOC[b] = 3000 | | | |
|---|---|---|---|---|---|---|---|
| | | | | Baseline No-R[e] | PF5-R[f] | PF10-R[g] | Eng. Controls[h] |
| Mixing/Loading to Support Groundboom Applications | Alfalfa, Birdsfoot Trefoil, Clover | 1.25 lb ai/acre | 200 acres | 4700 | 24000 | 47000 | 12000 |
| | Blueberry (lowbush) | 1.25 lb ai/acre | 80 acres | 12000 | 59000 | 120000 | 31000 |
| | Lespedeza, Vetch | 1.25 lb ai/acre | 80 acres | 12000 | 59000 | 120000 | 31000 |
| | Bermuda Grass | 1.25 lb ai/acre | 80 acres | 12000 | 59000 | 120000 | 31000 |
| | Broccoli, Broccoli Raab, Brussels Sprouts, Cabbage, Cauliflower, Chinese Broccoli, Dandelion | 1.25 lb ai/acre | 80 acres | 12000 | 59000 | 120000 | 31000 |
| | Endive. Kohlrabi, Chinese Greens, Watercress | 1.25 lb ai/acre | 80 acres | 12000 | 59000 | 120000 | 31000 |
| | Carrot, Garden Beets, Horseradish, Parsnip, Salsify, Turnip (greens & roots) | 1.25 lb ai/acre | 80 acres | 12000 | 59000 | 120000 | 31000 |
| | Asparagus | 1.25 lb ai/acre | 80 acres | 12000 | 59000 | 120000 | 31000 |
| | Blueberry (highbush), Currant | 1.25 lb ai/acre | 80 acres | 12000 | 59000 | 120000 | 31000 |
| | Okra | 1.2 lb ai/acre | 80 acres | 12000 | 61000 | 120000 | 32000 |
| | Oats, Rye, Spring Wheat, Winter Wheat | 1 lb ai/acre | 200 acres | 5900 | 29000 | 59000 | 16000 |
| | Corn (field), Sorghum | 1 lb ai/acre | 200 acres | 5900 | 29000 | 59000 | 16000 |
| | Peas - Succulent | 1 lb ai/acre | 80 acres | 15000 | 74000 | 150000 | 39000 |
| | Corn (pop and sweet) | 1 lb ai/acre | 80 acres | 15000 | 74000 | 150000 | 39000 |
| | Cantaloupe, Melon, Pumpkin, Winter Squash | 1 lb ai/acre | 80 acres | 15000 | 74000 | 150000 | 39000 |
| | Collard, Kale, Mustard Green, Swiss Chard | 1 lb ai/acre | 80 acres | 15000 | 74000 | 150000 | 39000 |
| | Peas - Succulent | 1 lb ai/acre | 80 acres | 15000 | 74000 | 150000 | 39000 |
| | Radish, Rutabaga | 1 lb ai/acre | 80 acres | 15000 | 74000 | 150000 | 39000 |
| | Passion Fruit | 1 lb ai/acre | 80 acres | 15000 | 74000 | 150000 | 39000 |
| | Flowers and Foliage Grown for Cutting | 1 lb ai/acre | 60 acres | 20000 | 98000 | 200000 | 52000 |

**Table I.2: Liquid Concentrate Formulations: Agricultural Non-ULV Applications Inhalation Risks**
**Summary of Malathion Occupational Handler Short / Intermediate-Term Inhalation Risks**

| Exposure Scenario | Crop | App. Rate[c] (lb ai/A or lb ai/Gal) | Amount Handled Per Day[d] (A or Gal) | Level of Personal Protective Equipment for Inhalation Exposures Inhalation MOE[a] – LOC[b] = 3000 | | | |
|---|---|---|---|---|---|---|---|
| | | | | Baseline No-R[e] | PF5-R[f] | PF10-R[g] | Eng. Controls[h] |
| Mixing/Loading to Support Groundboom Applications | Flowers, Shrubs, Flowering Plants, Nursery Stock, Woody Plants, Shade Trees (nursery grown) | 1 lb ai/acre | 60 acres | 20000 | 98000 | 200000 | 52000 |
| | Flowers, Shrubs, Flowering Plants, Nursery Stock, Woody Plants, Shade Trees (field grown) | 1 lb ai/acre | 40 acres | 29000 | 150000 | 290000 | 78000 |
| | Mint | 0.94 lb ai/acre | 80 acres | 16000 | 78000 | 160000 | 41000 |
| | Hops | 0.63 lb ai/acre | 80 acres | 24000 | 120000 | 240000 | 62000 |
| | Flax | 0.5 lb ai/acre | 200 acres | 12000 | 59000 | 120000 | 31000 |
| Mixing/Loading to Support Airblast Applications | Flowers and Foliage Grown for Cutting | 10 lb ai/acre | 20 acres | 5900 | 29000 | 59000 | 16000 |
| | Flowers, Shrubs, Flowering Plants, Nursery Stock, Woody Plants, Shade Trees (nursery grown) | 10 lb ai/acre | 20 acres | 5900 | 29000 | 59000 | 16000 |
| | Flowers, Shrubs, Flowering Plants, Nursery Stock, Woody Plants, Shade Trees (field grown) | 10 lb ai/acre | 10 acres | 12000 | 59000 | 120000 | 31000 |
| | CA ONLY: Grapefruit, Lemon, Lime, Orange, Tangelo, Tangerine | 7.5 lb ai/acre | 40 acres | 3900 | 20000 | 39000 | 10000 |
| | Avocado | 4.75 lb ai/acre | 40 acres | 6200 | 31000 | 62000 | 16000 |
| | Grapefruit, Lemon, Lime, Orange, Tangelo, Tangerine | 4.5 lb ai/acre | 40 acres | 6500 | 33000 | 65000 | 17000 |
| | Kumquat | 4.5 lb ai/acre | 40 acres | 6500 | 33000 | 65000 | 17000 |
| | Pine Seed Orchards, Christmas Tree Plantations | 3.2 lb ai/acre | 40 acres | 9200 | 46000 | 92000 | 24000 |

**Table I.2: Liquid Concentrate Formulations: Agricultural Non-ULV Applications Inhalation Risks**
**Summary of Malathion Occupational Handler Short / Intermediate-Term Inhalation Risks**

| Exposure Scenario | Crop | App. Rate[c] (lb ai/A or lb ai/Gal) | Amount Handled Per Day[d] (A or Gal) | Level of Personal Protective Equipment for Inhalation Exposures Inhalation MOE[a] – LOC[b] = 3000 | | | |
|---|---|---|---|---|---|---|---|
| | | | | Baseline No-R[e] | PF5-R[f] | PF10-R[g] | Eng. Controls[h] |
| Mixing/Loading to Support Airblast Applications | Nectarine, Peach | 3 lb ai/acre | 40 acres | 9800 | 49000 | 98000 | 26000 |
| | Chestnut, Pecans, Walnuts | 2.5 lb ai/acre | 40 acres | 12000 | 59000 | 120000 | 31000 |
| | Figs | 2 lb ai/acre | 40 acres | 15000 | 74000 | 150000 | 39000 |
| | Grapes (raisin, table, wine) | 1.88 lb ai/acre | 40 acres | 16000 | 78000 | 160000 | 41000 |
| | Cherry (Sweet and Tart) | 1.75 lb ai/acre | 40 acres | 17000 | 84000 | 170000 | 44000 |
| | Apricot | 1.5 lb ai/acre | 40 acres | 20000 | 98000 | 200000 | 52000 |
| | Grapefruit, Lemon, Lime, Orange, Tangelo, Tangerine | 1.5 lb ai/acre | 40 acres | 20000 | 98000 | 200000 | 52000 |
| | Pear | 1.25 lb ai/acre | 40 acres | 24000 | 120000 | 240000 | 62000 |
| | FL ONLY: Lemon | 1.25 lb ai/acre | 40 acres | 24000 | 120000 | 240000 | 62000 |
| | Guava, Papaya | 1.25 lb ai/acre | 40 acres | 24000 | 120000 | 240000 | 62000 |
| | Blueberry (highbush) | 1.25 lb ai/acre | 40 acres | 24000 | 120000 | 240000 | 62000 |
| | Passion Fruit | 1 lb ai/acre | 40 acres | 29000 | 150000 | 290000 | 78000 |
| | Mango | 0.94 lb ai/acre | 40 acres | 31000 | 160000 | 310000 | 83000 |
| | Macadamia Nut | 0.94 lb ai/acre | 40 acres | 31000 | 160000 | 310000 | 83000 |
| | Hops | 0.63 lb ai/acre | 40 acres | 47000 | 240000 | 470000 | 120000 |
| Mixing/Loading to Support Dip Applications | Grape Root | 0.019 lb ai/gal | 100 gallons | 620000 | 3100000 | 6200000 | 1600000 |
| **Applicators** | | | | | | | |
| Aerial Applicators | CA ONLY: Grapefruit, Lemon, Lime, Orange, Tangelo, Tangerine | 7.5 lb ai/acre | 350 acres | No Data | No Data | No Data | 20000 |
| | Avocado | 4.75 lb ai/acre | 350 acres | No Data | No Data | No Data | 32000 |
| | Grapefruit, Lemon, Lime, Orange, Tangelo, Tangerine | 4.5 lb ai/acre | 350 acres | No Data | No Data | No Data | 33000 |
| | Kumquat | 4.5 lb ai/acre | 350 acres | No Data | No Data | No Data | 33000 |
| | Pine Seed Orchards, Christmas Tree Plantations | 3.2 lb ai/acre | 1200 acres | No Data | No Data | No Data | 14000 |
| | Nectarine, Peach | 3 lb ai/acre | 350 acres | No Data | No Data | No Data | 50000 |

**Table I.2: Liquid Concentrate Formulations: Agricultural Non-ULV Applications Inhalation Risks**
**Summary of Malathion Occupational Handler Short / Intermediate-Term Inhalation Risks**

| Exposure Scenario | Crop | App. Rate[c] (lb ai/A or lb ai/Gal) | Amount Handled Per Day[d] (A or Gal) | Level of Personal Protective Equipment for Inhalation Exposures Inhalation MOE[a] – LOC[b] = 3000 | | | |
|---|---|---|---|---|---|---|---|
| | | | | Baseline No-R[e] | PF5-R[f] | PF10-R[g] | Eng. Controls[h] |
| Aerial Applicators | Cotton | 2.5 lb ai/acre | 1200 acres | No Data | No Data | No Data | 18000 |
| | Chestnut, Pecans, Walnuts | 2.5 lb ai/acre | 350 acres | No Data | No Data | No Data | 60000 |
| | Strawberry | 2 lb ai/acre | 350 acres | No Data | No Data | No Data | 75000 |
| | Figs | 2 lb ai/acre | 350 acres | No Data | No Data | No Data | 75000 |
| | Spinach | 2 lb ai/acre | 350 acres | No Data | No Data | No Data | 75000 |
| | Pineapple | 2 lb ai/acre | 350 acres | No Data | No Data | No Data | 75000 |
| | Blackberry, Boysenberry, Dewberry, Loganberry, Raspberry | 2 lb ai/acre | 350 acres | No Data | No Data | No Data | 75000 |
| | Gooseberry | 2 lb ai/acre | 350 acres | No Data | No Data | No Data | 75000 |
| | Lettuce, head and leaf | 1.88 lb ai/acre | 350 acres | No Data | No Data | No Data | 80000 |
| | Grapes (raisin, table, wine) | 1.88 lb ai/acre | 350 acres | No Data | No Data | No Data | 80000 |
| | Cherry (Sweet and Tart) | 1.75 lb ai/acre | 350 acres | No Data | No Data | No Data | 86000 |
| | Chayote Fruit, Cucumber, Summer Squash | 1.75 lb ai/acre | 350 acres | No Data | No Data | No Data | 86000 |
| | Eggplant, Oriental Eggplant, Pepper, Tomato, Tomatillo | 1.56 lb ai/acre | 350 acres | No Data | No Data | No Data | 96000 |
| | Chayote Root, Garlic, Leeks, Onion, Potatoes, Shallot, Sweet Potatoes, Yams | 1.56 lb ai/acre | 350 acres | No Data | No Data | No Data | 96000 |
| | Apricot | 1.5 lb ai/acre | 350 acres | No Data | No Data | No Data | 100000 |
| | Grapefruit, Lemon, Lime, Orange, Tangelo, Tangerine | 1.5 lb ai/acre | 350 acres | No Data | No Data | No Data | 100000 |
| | Watermelon | 1.5 lb ai/acre | 350 acres | No Data | No Data | No Data | 100000 |
| | Celery, Parsley | 1.5 lb ai/acre | 350 acres | No Data | No Data | No Data | 100000 |
| | Barley, Rice, Wild Rice | 1.25 lb ai/acre | 1200 acres | No Data | No Data | No Data | 35000 |
| | Grass - Forage and Hay | 1.25 lb ai/acre | 1200 acres | No Data | No Data | No Data | 35000 |
| | Alfalfa, Birdsfoot Trefoil, Clover | 1.25 lb ai/acre | 1200 acres | No Data | No Data | No Data | 35000 |
| | Blueberry, lowbush | 1.25 lb ai/acre | 350 acres | No Data | No Data | No Data | 120000 |

**Table I.2: Liquid Concentrate Formulations: Agricultural Non-ULV Applications Inhalation Risks**
**Summary of Malathion Occupational Handler Short / Intermediate-Term Inhalation Risks**

| Exposure Scenario | Crop | App. Rate[c] (lb ai/A or lb ai/Gal) | Amount Handled Per Day[d] (A or Gal) | Level of Personal Protective Equipment for Inhalation Exposures Inhalation MOE[a] – LOC[b] = 3000 | | | |
|---|---|---|---|---|---|---|---|
| | | | | Baseline No-R[e] | PF5-R[f] | PF10-R[g] | Eng. Controls[h] |
| Aerial Applicators | Lespedeza, Vetch | 1.25 lb ai/acre | 350 acres | No Data | No Data | No Data | 120000 |
| | Bermuda Grass | 1.25 lb ai/acre | 350 acres | No Data | No Data | No Data | 120000 |
| | Pear | 1.25 lb ai/acre | 350 acres | No Data | No Data | No Data | 120000 |
| | FL ONLY: Lemon | 1.25 lb ai/acre | 350 acres | No Data | No Data | No Data | 120000 |
| | Guava, Papaya | 1.25 lb ai/acre | 350 acres | No Data | No Data | No Data | 120000 |
| | Broccoli, Broccoli Raab, Brussels Sprouts, Cabbage, Cauliflower, Chinese Broccoli, Dandelion | 1.25 lb ai/acre | 350 acres | No Data | No Data | No Data | 120000 |
| | Endive. Kohlrabi, Chinese Greens, Watercress | 1.25 lb ai/acre | 350 acres | No Data | No Data | No Data | 120000 |
| | Carrot, Garden Beets, Horseradish, Parsnip, Salsify, Turnip (greens & roots) | 1.25 lb ai/acre | 350 acres | No Data | No Data | No Data | 120000 |
| | Asparagus | 1.25 lb ai/acre | 350 acres | No Data | No Data | No Data | 120000 |
| | Blueberry (highbush), Currant | 1.25 lb ai/acre | 350 acres | No Data | No Data | No Data | 120000 |
| | Okra | 1.2 lb ai/acre | 350 acres | No Data | No Data | No Data | 130000 |
| | Oats, Rye, Spring Wheat, Winter Wheat | 1 lb ai/acre | 1200 acres | No Data | No Data | No Data | 44000 |
| | Corn (field), Sorghum | 1 lb ai/acre | 1200 acres | No Data | No Data | No Data | 44000 |
| | Peas - Succulent | 1 lb ai/acre | 350 acres | No Data | No Data | No Data | 150000 |
| | Corn (pop and sweet) | 1 lb ai/acre | 350 acres | No Data | No Data | No Data | 150000 |
| | Cantaloupe, Melon, Pumpkin, Winter Squash | 1 lb ai/acre | 350 acres | No Data | No Data | No Data | 150000 |
| | Collard, Kale, Mustard Green, Swiss Chard | 1 lb ai/acre | 350 acres | No Data | No Data | No Data | 150000 |
| | Peas - Succulent | 1 lb ai/acre | 350 acres | No Data | No Data | No Data | 150000 |
| | Radish, Rutabaga | 1 lb ai/acre | 350 acres | No Data | No Data | No Data | 150000 |
| | Passion Fruit | 1 lb ai/acre | 350 acres | No Data | No Data | No Data | 150000 |

**Table I.2: Liquid Concentrate Formulations: Agricultural Non-ULV Applications Inhalation Risks**
**Summary of Malathion Occupational Handler Short / Intermediate-Term Inhalation Risks**

| Exposure Scenario | Crop | App. Rate[c] (lb ai/A or lb ai/Gal) | Amount Handled Per Day[d] (A or Gal) | Level of Personal Protective Equipment for Inhalation Exposures Inhalation MOE[a] – LOC[b] = 3000 | | | |
|---|---|---|---|---|---|---|---|
| | | | | Baseline No-R[e] | PF5-R[f] | PF10-R[g] | Eng. Controls[h] |
| Aerial Applicators | Mint | 0.94 lb ai/acre | 350 acres | No Data | No Data | No Data | 160000 |
| | Mango | 0.94 lb ai/acre | 350 acres | No Data | No Data | No Data | 160000 |
| | Macadamia Nut | 0.94 lb ai/acre | 350 acres | No Data | No Data | No Data | 160000 |
| | Hops | 0.63 lb ai/acre | 350 acres | No Data | No Data | No Data | 240000 |
| | Flax | 0.5 lb ai/acre | 1200 acres | No Data | No Data | No Data | 88000 |
| | Flowers and Foliage Grown for Cutting | 0.25 lb ai/acre | 60 acres | No Data | No Data | No Data | 3500000 |
| | Flowers, Shrubs, Flowering Plants, Nursery Stock, Woody Plants, Shade Trees (nursery grown) | 0.25 lb ai/acre | 60 acres | No Data | No Data | No Data | 3500000 |
| | Flowers, Shrubs, Flowering Plants, Nursery Stock, Woody Plants, Shade Trees (field grown) | 0.25 lb ai/acre | 40 acres | No Data | No Data | No Data | 5300000 |
| Groundboom Applicators | Cotton | 2.5 lb ai/acre | 200 acres | 1500 | 7600 | 15000 | 12000 |
| | Strawberry | 2 lb ai/acre | 80 acres | 4700 | 24000 | 47000 | 38000 |
| | Spinach | 2 lb ai/acre | 80 acres | 4700 | 24000 | 47000 | 38000 |
| | Pineapple | 2 lb ai/acre | 80 acres | 4700 | 24000 | 47000 | 38000 |
| | Blackberry, Boysenberry, Dewberry, Loganberry, Raspberry | 2 lb ai/acre | 80 acres | 4700 | 24000 | 47000 | 38000 |
| | Gooseberry | 2 lb ai/acre | 80 acres | 4700 | 24000 | 47000 | 38000 |
| | Lettuce, head and leaf | 1.88 lb ai/acre | 80 acres | 5000 | 25000 | 50000 | 40000 |
| | Grapes (raisin, table, wine) | 1.88 lb ai/acre | 80 acres | 5000 | 25000 | 50000 | 40000 |
| | Chayote Fruit, Cucumber, Summer Squash | 1.75 lb ai/acre | 80 acres | 5400 | 27000 | 54000 | 43000 |
| | Eggplant, Oriental Eggplant, Pepper, Tomato, Tomatillo | 1.56 lb ai/acre | 80 acres | 6100 | 30000 | 61000 | 48000 |
| | Chayote Root, Garlic, Leeks, Onion, Potatoes, Shallot, Sweet Potatoes, Yams | 1.56 lb ai/acre | 80 acres | 6100 | 30000 | 61000 | 48000 |

**Table I.2: Liquid Concentrate Formulations: Agricultural Non-ULV Applications Inhalation Risks**
**Summary of Malathion Occupational Handler Short / Intermediate-Term Inhalation Risks**

| Exposure Scenario | Crop | App. Rate[c] (lb ai/A or lb ai/Gal) | Amount Handled Per Day[d] (A or Gal) | Level of Personal Protective Equipment for Inhalation Exposures Inhalation MOE[a] – LOC[b] = 3000 | | | |
|---|---|---|---|---|---|---|---|
| | | | | Baseline No-R[e] | PF5-R[f] | PF10-R[g] | Eng. Controls[h] |
| Groundboom Applicators | Watermelon | 1.5 lb ai/acre | 80 acres | 6300 | 32000 | 63000 | 50000 |
| | Celery, Parsley | 1.5 lb ai/acre | 80 acres | 6300 | 32000 | 63000 | 50000 |
| | Barley, Rice, Wild Rice | 1.25 lb ai/acre | 200 acres | 3000 | 15000 | 30000 | 24000 |
| | Grass - Forage and Hay | 1.25 lb ai/acre | 200 acres | 3000 | 15000 | 30000 | 24000 |
| | Alfalfa, Birdsfoot Trefoil, Clover | 1.25 lb ai/acre | 200 acres | 3000 | 15000 | 30000 | 24000 |
| | Blueberry (lowbush) | 1.25 lb ai/acre | 80 acres | 7600 | 38000 | 76000 | 60000 |
| | Lespedeza, Vetch | 1.25 lb ai/acre | 80 acres | 7600 | 38000 | 76000 | 60000 |
| | Bermuda Grass | 1.25 lb ai/acre | 80 acres | 7600 | 38000 | 76000 | 60000 |
| | Broccoli, Broccoli Raab, Brussels Sprouts, Cabbage, Cauliflower, Chinese | 1.25 lb ai/acre | 80 acres | 7600 | 38000 | 76000 | 60000 |
| | Broccoli, Dandelion Endive. Kohlrabi, Chinese Greens, Watercress | 1.25 lb ai/acre | 80 acres | 7600 | 38000 | 76000 | 60000 |
| | Carrot, Garden Beets, Horseradish, Parsnip, Salsify, Turnip (greens & roots) | 1.25 lb ai/acre | 80 acres | 7600 | 38000 | 76000 | 60000 |
| | Asparagus | 1.25 lb ai/acre | 80 acres | 7600 | 38000 | 76000 | 60000 |
| | Blueberry (highbush), Currant | 1.25 lb ai/acre | 80 acres | 7600 | 38000 | 76000 | 60000 |
| | Okra | 1.2 lb ai/acre | 80 acres | 7900 | 40000 | 79000 | 62000 |
| | Oats, Rye, Spring Wheat, Winter Wheat | 1 lb ai/acre | 200 acres | 3800 | 19000 | 38000 | 30000 |
| | Corn (field), Sorghum | 1 lb ai/acre | 200 acres | 3800 | 19000 | 38000 | 30000 |
| | Peas - Succulent | 1 lb ai/acre | 80 acres | 9500 | 47000 | 95000 | 75000 |
| | Corn (pop and sweet) | 1 lb ai/acre | 80 acres | 9500 | 47000 | 95000 | 75000 |
| | Cantaloupe, Melon, Pumpkin, Winter Squash | 1 lb ai/acre | 80 acres | 9500 | 47000 | 95000 | 75000 |

**Table I.2: Liquid Concentrate Formulations: Agricultural Non-ULV Applications Inhalation Risks**
**Summary of Malathion Occupational Handler Short / Intermediate-Term Inhalation Risks**

| Exposure Scenario | Crop | App. Rate[c] (lb ai/A or lb ai/Gal) | Amount Handled Per Day[d] (A or Gal) | Level of Personal Protective Equipment for Inhalation Exposures Inhalation MOE[a] – LOC[b] = 3000 | | | |
|---|---|---|---|---|---|---|---|
| | | | | Baseline No-R[e] | PF5-R[f] | PF10-R[g] | Eng. Controls[h] |
| Groundboom Applicators | Collard, Kale, Mustard Green, Swiss Chard | 1 lb ai/acre | 80 acres | 9500 | 47000 | 95000 | 75000 |
| | Peas - Succulent | 1 lb ai/acre | 80 acres | 9500 | 47000 | 95000 | 75000 |
| | Radish, Rutabaga | 1 lb ai/acre | 80 acres | 9500 | 47000 | 95000 | 75000 |
| | Passion Fruit | 1 lb ai/acre | 80 acres | 9500 | 47000 | 95000 | 75000 |
| | Flowers and Foliage Grown for Cutting | 1 lb ai/acre | 60 acres | 13000 | 63000 | 130000 | 100000 |
| | Flowers, Shrubs, Flowering Plants, Nursery Stock, Woody Plants, Shade Trees (nursery grown) | 1 lb ai/acre | 60 acres | 13000 | 63000 | 130000 | 100000 |
| | Flowers, Shrubs, Flowering Plants, Nursery Stock, Woody Plants, Shade Trees (field grown) | 1 lb ai/acre | 40 acres | 19000 | 95000 | 190000 | 150000 |
| | Mint | 0.94 lb ai/acre | 80 acres | 10000 | 50000 | 100000 | 80000 |
| | Hops | 0.63 lb ai/acre | 80 acres | 15000 | 75000 | 150000 | 120000 |
| | Flax | 0.5 lb ai/acre | 200 acres | 7600 | 38000 | 76000 | 60000 |
| Airblast Applicators | Flowers and Foliage Grown for Cutting | 10 lb ai/acre | 20 acres | 270 | 1400 | 2700 | 19000 |
| | Flowers, Shrubs, Flowering Plants, Nursery Stock, Woody Plants, Shade Trees (nursery grown) | 10 lb ai/acre | 20 acres | 270 | 1400 | 2700 | 19000 |
| | Flowers, Shrubs, Flowering Plants, Nursery Stock, Woody Plants, Shade Trees (field grown) | 10 lb ai/acre | 10 acres | 550 | 2700 | 5500 | 38000 |
| | CA ONLY: Grapefruit, Lemon, Lime, Orange, Tangelo, Tangerine | 7.5 lb ai/acre | 40 acres | 180 | 910 | 1800 | 13000 |

**Table I.2: Liquid Concentrate Formulations: Agricultural Non-ULV Applications Inhalation Risks**
**Summary of Malathion Occupational Handler Short / Intermediate-Term Inhalation Risks**

| Exposure Scenario | Crop | App. Rate[c] (lb ai/A or lb ai/Gal) | Amount Handled Per Day[d] (A or Gal) | Level of Personal Protective Equipment for Inhalation Exposures Inhalation MOE[a] – LOC[b] = 3000 | | | |
|---|---|---|---|---|---|---|---|
| | | | | Baseline No-R[e] | PF5-R[f] | PF10-R[g] | Eng. Controls[h] |
| Airblast Applicators | Avocado | 4.75 lb ai/acre | 40 acres | 290 | 1400 | 2900 | 20000 |
| | Grapefruit, Lemon, Lime, Orange, Tangelo, Tangerine | 4.5 lb ai/acre | 40 acres | 300 | 1500 | 3000 | 21000 |
| | Kumquat | 4.5 lb ai/acre | 40 acres | 300 | 1500 | 3000 | 21000 |
| | Pine Seed Orchards, Christmas Tree Plantations | 3.2 lb ai/acre | 40 acres | 430 | 2100 | 4300 | 30000 |
| | Nectarine, Peach | 3 lb ai/acre | 40 acres | 460 | 2300 | 4600 | 32000 |
| | Chestnut, Pecans, Walnuts | 2.5 lb ai/acre | 40 acres | 550 | 2700 | 5500 | 38000 |
| | Figs | 2 lb ai/acre | 40 acres | 680 | 3400 | 6800 | 47000 |
| | Grapes (raisin, table, wine) | 1.88 lb ai/acre | 40 acres | 730 | 3600 | 7300 | 50000 |
| | Cherry (Sweet and Tart) | 1.75 lb ai/acre | 40 acres | 780 | 3900 | 7800 | 54000 |
| | Apricot | 1.5 lb ai/acre | 40 acres | 910 | 4600 | 9100 | 63000 |
| | Grapefruit, Lemon, Lime, Orange, Tangelo, Tangerine | 1.5 lb ai/acre | 40 acres | 910 | 4600 | 9100 | 63000 |
| | Pear | 1.25 lb ai/acre | 40 acres | 1100 | 5500 | 11000 | 76000 |
| | FL ONLY: Lemon | 1.25 lb ai/acre | 40 acres | 1100 | 5500 | 11000 | 76000 |
| | Guava, Papaya | 1.25 lb ai/acre | 40 acres | 1100 | 5500 | 11000 | 76000 |
| | Blueberries (highbush) | 1.25 lb ai/acre | 40 acres | 1100 | 5500 | 11000 | 76000 |
| | Passion Fruit | 1 lb ai/acre | 40 acres | 1400 | 6800 | 14000 | 95000 |
| | Mango | 0.94 lb ai/acre | 40 acres | 1500 | 7300 | 15000 | 100000 |
| | Macadamia Nut | 0.94 lb ai/acre | 40 acres | 1500 | 7300 | 15000 | 100000 |
| | Hops | 0.63 lb ai/acre | 40 acres | 2200 | 11000 | 22000 | 150000 |
| Dip Applicators | Grape Root | 0.019 lb ai/gal | 100 gallons | No Data | No Data | No Data | No Data |
| **Flaggers** | | | | | | | |

**Table I.2: Liquid Concentrate Formulations: Agricultural Non-ULV Applications Inhalation Risks**
**Summary of Malathion Occupational Handler Short / Intermediate-Term Inhalation Risks**

| Exposure Scenario | Crop | App. Rate[c] (lb ai/A or lb ai/Gal) | Amount Handled Per Day[d] (A or Gal) | Level of Personal Protective Equipment for Inhalation Exposures Inhalation MOE[a] – LOC[b] = 3000 | | | |
|---|---|---|---|---|---|---|---|
| | | | | Baseline No-R[e] | PF5-R[f] | PF10-R[g] | Eng. Controls[h] |
| Flagging to Support Aerial Applications | CA ONLY: Grapefruit, Lemon, Lime, Orange, Tangelo, Tangerine | 7.5 lb ai/acre | 350 acres | 280 | 1400 | 2800 | No Data |
| | Avocado | 4.75 lb ai/acre | 350 acres | 440 | 2200 | 4400 | No Data |
| | Grapefruit, Lemon, Lime, Orange, Tangelo, Tangerine | 4.5 lb ai/acre | 350 acres | 470 | 2400 | 4700 | No Data |
| | Kumquat | 4.5 lb ai/acre | 350 acres | 470 | 2400 | 4700 | No Data |
| | Pine Seed Orchards, Christmas Tree Plantations | 3.2 lb ai/acre | 350 acres | 660 | 3300 | 6600 | No Data |
| | Nectarine, Peach | 3 lb ai/acre | 350 acres | 700 | 3500 | 7000 | No Data |
| | Cotton | 2.5 lb ai/acre | 350 acres | 840 | 4200 | 8400 | No Data |
| | Chestnut, Pecans, Walnuts | 2.5 lb ai/acre | 350 acres | 840 | 4200 | 8400 | No Data |
| | Strawberry | 2 lb ai/acre | 350 acres | 1100 | 5300 | 11000 | No Data |
| | Figs | 2 lb ai/acre | 350 acres | 1100 | 5300 | 11000 | No Data |
| | Spinach | 2 lb ai/acre | 350 acres | 1100 | 5300 | 11000 | No Data |
| | Pineapple | 2 lb ai/acre | 350 acres | 1100 | 5300 | 11000 | No Data |
| | Blackberry, Boysenberry, Dewberry, Loganberry, Raspberry | 2 lb ai/acre | 350 acres | 1100 | 5300 | 11000 | No Data |
| | Gooseberry | 2 lb ai/acre | 350 acres | 1100 | 5300 | 11000 | No Data |
| | Lettuce, head and leaf | 1.88 lb ai/acre | 350 acres | 1100 | 5600 | 11000 | No Data |
| | Grapes (raisin, table, wine) | 1.88 lb ai/acre | 350 acres | 1100 | 5600 | 11000 | No Data |
| Flagging to Support Aerial Applications | Cherry (Sweet and Tart) | 1.75 lb ai/acre | 350 acres | 1200 | 6000 | 12000 | No Data |
| | Chayote Fruit, Cucumber, Summer Squash | 1.75 lb ai/acre | 350 acres | 1200 | 6000 | 12000 | No Data |
| | Eggplant, Oriental Eggplant, Pepper, Tomato, Tomatillo | 1.56 lb ai/acre | 350 acres | 1400 | 6800 | 14000 | No Data |
| | Chayote Root, Garlic, Leeks, Onion, Potatoes, Shallot, Sweet Potatoes, Yams | 1.56 lb ai/acre | 350 acres | 1400 | 6800 | 14000 | No Data |
| | Apricot | 1.5 lb ai/acre | 350 acres | 1400 | 7000 | 14000 | No Data |

**Table I.2: Liquid Concentrate Formulations: Agricultural Non-ULV Applications Inhalation Risks**
**Summary of Malathion Occupational Handler Short / Intermediate-Term Inhalation Risks**

| Exposure Scenario | Crop | App. Rate[c] (lb ai/A or lb ai/Gal) | Amount Handled Per Day[d] (A or Gal) | Level of Personal Protective Equipment for Inhalation Exposures Inhalation MOE[a] – LOC[b] = 3000 | | | |
|---|---|---|---|---|---|---|---|
| | | | | Baseline No-R[e] | PF5-R[f] | PF10-R[g] | Eng. Controls[h] |
| Flagging to Support Aerial Applications | Grapefruit, Lemon, Lime, Orange, Tangelo, Tangerine | 1.5 lb ai/acre | 350 acres | 1400 | 7000 | 14000 | No Data |
| | Watermelon | 1.5 lb ai/acre | 350 acres | 1400 | 7000 | 14000 | No Data |
| | Celery, Parsley | 1.5 lb ai/acre | 350 acres | 1400 | 7000 | 14000 | No Data |
| | Blueberry, lowbush | 1.25 lb ai/acre | 350 acres | 1700 | 8400 | 17000 | No Data |
| | Barley, Rice, Wild Rice | 1.25 lb ai/acre | 350 acres | 1700 | 8400 | 17000 | No Data |
| | Grass - Forage and Hay | 1.25 lb ai/acre | 350 acres | 1700 | 8400 | 17000 | No Data |
| | Alfalfa, Birdsfoot Trefoil, Clover | 1.25 lb ai/acre | 350 acres | 1700 | 8400 | 17000 | No Data |
| | Lespedeza, Vetch | 1.25 lb ai/acre | 350 acres | 1700 | 8400 | 17000 | No Data |
| | Bermuda Grass | 1.25 lb ai/acre | 350 acres | 1700 | 8400 | 17000 | No Data |
| | Pear | 1.25 lb ai/acre | 350 acres | 1700 | 8400 | 17000 | No Data |
| | FL ONLY: Lemon | 1.25 lb ai/acre | 350 acres | 1700 | 8400 | 17000 | No Data |
| | Guava, Papaya | 1.25 lb ai/acre | 350 acres | 1700 | 8400 | 17000 | No Data |
| | Broccoli, Broccoli Raab, Brussels Sprouts, Cabbage, Cauliflower, Chinese | 1.25 lb ai/acre | 350 acres | 1700 | 8400 | 17000 | No Data |
| | Broccoli, Dandelion Endive. Kohlrabi, Chinese Greens, Watercress | 1.25 lb ai/acre | 350 acres | 1700 | 8400 | 17000 | No Data |
| | Carrot, Garden Beets, Horseradish, Parsnip, Salsify, Turnip (greens & roots) | 1.25 lb ai/acre | 350 acres | 1700 | 8400 | 17000 | No Data |
| | Asparagus | 1.25 lb ai/acre | 350 acres | 1700 | 8400 | 17000 | No Data |
| | Blueberry (highbush), Currant | 1.25 lb ai/acre | 350 acres | 1700 | 8400 | 17000 | No Data |
| | Okra | 1.2 lb ai/acre | 350 acres | 1800 | 8800 | 18000 | No Data |
| | Oats, Rye, Spring Wheat, Winter Wheat | 1 lb ai/acre | 350 acres | 2100 | 11000 | 21000 | No Data |
| | Peas - Succulent | 1 lb ai/acre | 350 acres | 2100 | 11000 | 21000 | No Data |
| | Corn (field), Sorghum | 1 lb ai/acre | 350 acres | 2100 | 11000 | 21000 | No Data |
| | Corn (pop and sweet) | 1 lb ai/acre | 350 acres | 2100 | 11000 | 21000 | No Data |

**Table I.2: Liquid Concentrate Formulations: Agricultural Non-ULV Applications Inhalation Risks**
**Summary of Malathion Occupational Handler Short / Intermediate-Term Inhalation Risks**

| Exposure Scenario | Crop | App. Rate[c] (lb ai/A or lb ai/Gal) | Amount Handled Per Day[d] (A or Gal) | Level of Personal Protective Equipment for Inhalation Exposures Inhalation MOE[a] – LOC[b] = 3000 | | | |
|---|---|---|---|---|---|---|---|
| | | | | Baseline No-R[e] | PF5-R[f] | PF10-R[g] | Eng. Controls[h] |
| Flagging to Support Aerial Applications | Cantaloupe, Melon, Pumpkin, Winter Squash | 1 lb ai/acre | 350 acres | 2100 | 11000 | 21000 | No Data |
| | Collard, Kale, Mustard Green, Swiss Chard | 1 lb ai/acre | 350 acres | 2100 | 11000 | 21000 | No Data |
| | Peas - Succulent | 1 lb ai/acre | 350 acres | 2100 | 11000 | 21000 | No Data |
| | Radish, Rutabaga | 1 lb ai/acre | 350 acres | 2100 | 11000 | 21000 | No Data |
| | Passion Fruit | 1 lb ai/acre | 350 acres | 2100 | 11000 | 21000 | No Data |
| | Mint | 0.94 lb ai/acre | 350 acres | 2200 | 11000 | 22000 | No Data |
| | Mango | 0.94 lb ai/acre | 350 acres | 2200 | 11000 | 22000 | No Data |
| | Macadamia Nut | 0.94 lb ai/acre | 350 acres | 2200 | 11000 | 22000 | No Data |
| | Hops | 0.63 lb ai/acre | 350 acres | 3300 | 17000 | 33000 | No Data |
| | Flax | 0.5 lb ai/acre | 350 acres | 4200 | 21000 | 42000 | No Data |
| | Flowers and Foliage Grown for Cutting | 0.25 lb ai/acre | 60 acres | 49000 | 250000 | 490000 | No Data |
| | Flowers, Shrubs, Flowering Plants, Nursery Stock, Woody Plants, Shade Trees (nursery grown) | 0.25 lb ai/acre | 60 acres | 49000 | 250000 | 490000 | No Data |
| | Flowers, Shrubs, Flowering Plants, Nursery Stock, Woody Plants, Shade Trees (field grown) | 0.25 lb ai/acre | 40 acres | 74000 | 370000 | 740000 | No Data |
| **Mixer/Loader/Applicators** | | | | | | | |
| Mixing/Loading/ Applying with Backpack Equipment | Pine Seed Orchards, Christmas Tree Plantations | 3.2 lb ai/acre | 5 acres | 230 | 1200 | 2400 | No Data |
| | Mushroom | 1.7 lb ai/acre | 0.37 acres | 5900 | 30000 | 59000 | No Data |
| | Flowers and Foliage Grown for Cutting | 0.025 lb ai/gallon | 40 gallons | 3700 | 19000 | 37000 | No Data |
| | Flowers, Shrubs, Flowering Plants, Nursery Stock, Woody | 0.025 lb ai/gallon | 40 gallons | 3700 | 19000 | 37000 | No Data |

**Table I.2: Liquid Concentrate Formulations: Agricultural Non-ULV Applications Inhalation Risks**
**Summary of Malathion Occupational Handler Short / Intermediate-Term Inhalation Risks**

| Exposure Scenario | Crop | App. Rate[c] (lb ai/A or lb ai/Gal) | Amount Handled Per Day[d] (A or Gal) | Level of Personal Protective Equipment for Inhalation Exposures Inhalation MOE[a] – LOC[b] = 3000 | | | |
|---|---|---|---|---|---|---|---|
| | | | | Baseline No-R[e] | PF5-R[f] | PF10-R[g] | Eng. Controls[h] |
| Mixing/Loading/ Applying with Dip Equipment | Plants, Shade Trees (foliar-directed) Flowers, Shrubs, Flowering Plants, Nursery Stock, Woody Plants, Shade Trees (ground-directed) | 0.025 lb ai/gallon | 40 gallons | 100000 | 500000 | 1000000 | No Data |
| | Grape Root | 0.019 lb ai/gallon | 100 gallons | No Data | No Data | No Data | No Data |
| Mixing/Loading/ Applying with Handheld Fogger Equipment | Mushroom | 1.7 lb ai/acre | 0.37 acres | No Data | No Data | No Data | No Data |
| Mixing/Loading/ Applying with Manually-Pressurized Handwand Equipment | Pine Seed Orchards, Christmas Tree Plantations | 3.2 lb ai/acre | 5 acres | 540 | 2700 | 5400 | No Data |
| | Mushroom | 1.7 lb ai/acre | 0.37 acres | 14000 | 68000 | 140000 | No Data |
| Mixing/Loading/ Applying with Manually-Pressurized Handwand Equipment | Flowers and Foliage Grown for Cutting | 0.025 lb ai/gallon | 40 gallons | 8600 | 43000 | 86000 | No Data |
| | Flowers, Shrubs, Flowering Plants, Nursery Stock, Woody Plants, Shade Trees (foliar or ground-directed) | 0.025 lb ai/gallon | 40 gallons | 8600 | 43000 | 86000 | No Data |
| Mixing/Loading/ Applying with Mechanically-Pressurized Handgun Equipment | Pine Seed Orchards, Christmas Tree Plantations | 3.2 lb ai/acre | 5 acres | 1900 | 9300 | 19000 | No Data |
| | Mushroom | 1.7 lb ai/acre | 0.37 acres | 3400 | 17000 | 34000 | No Data |
| | Flowers and Foliage Grown for Cutting | 0.025 lb ai/acre | 1000 gallons | 1200 | 5900 | 12000 | No Data |
| | Flowers, Shrubs, Flowering Plants, Nursery Stock, Woody Plants, Shade Trees (foliar or ground-directed) | 0.025 lb ai/gallon | 1000 gallons | 1200 | 5900 | 12000 | No Data |

a MOE = margin of exposure = Inhalation Point of Departure (mg/kg/day)/ Inhalation Dose (mg/kg/day); where inhalation dose = daily unit exposure (mg/lb ai) x application rate x amount handled per day x 100% inhalation absorption (route-specific PoD) / bodyweight (69 kg average female adult). The inhalation Point of Departure is 3.74 mg/kg/day.

b LOC = level of concern = 3000.

c Application rates are the maximum application rates determined from EPA registered labels for malathion.

d Amount handled per day values are HED estimates of acres treated per day or gallons applied per day based on industry sources and HED estimates.

e Baseline = no respirator.

f PF5-R = particulate filtering respirator. These respirators provide respiratory protection of 80% or higher.

g PF10-R = half-or full-face respirator with a particulate filter (N, P, or R) or powered air purifying respirator (PAPR) equipped with an HE filter. These respirators provide respiratory protection of 90% or higher.

h Eng. Controls = Closed mixing/loading systems, enclosed cabs, and enclosed cockpits..

**Table I.3: Liquid Concentrate Formulations: Non-Agricultural Non-ULV Applications Dermal Risks**
**Summary of Malathion Occupational Handler Short- / Intermediate-Term Dermal Risks**

| Exposure Scenario | Use Site | App. Rate[c] (lb ai/A or /Gal) | Amount Handled Per Day[d] (A, Sq Ft or Gal) | Level of Personal Protective Equipment for Dermal Exposures Dermal MOE[a] – LOC[b] = 1000 | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | | | Baseline[e] | SL/GL[f] | DL/GL[g] | SL/GL/CRH[h] | DL/GL/CRH[i] | Eng. Controls[j] |
| **Mixer/Loaders** | | | | | | | | | |
| Mixing/Loading to Support Aerial Applications | Agricultural Uncultivated Areas | 1 lb ai/acre | 350 A | 71 | 420 | 540 | No Data | No Data | 1800 |
| | Non-Agricultural Uncultivated Areas/Soils | 0.6 lb ai/acre | 350 A | 120 | 700 | 900 | No Data | No Data | 3100 |
| | Intermittently Flooded Areas, Swamps/ Marshes/ Stagnant Water | 0.51 lb ai/acre | 350 A | 140 | 820 | 1100 | No Data | No Data | 3600 |
| Mixing/Loading to Support Groundboom Application | Agricultural Uncultivated Areas | 1 lb ai/acre | 80 A | 310 | 1800 | 2400 | No Data | No Data | 8000 |
| | Non-Agricultural Uncultivated Areas/Soils | 0.6 lb ai/acre | 80 A | 520 | 3100 | 3900 | No Data | No Data | 13000 |
| Mixing/Loading to Support Truck-Mounted Fogger Applications | Intermittently Flooded Areas, Swamps/ Marshes/ Stagnant Water | 0.51 lb ai/acre | 200 A | 250 | 1400 | 1900 | No Data | No Data | 6300 |
| Mixing/Loading to Support Mechanically Pressurized Handgun Applications | Fence Rows/Hedge Rows | 10.45 lb ai/acre | 60 A | 40 | 230 | 300 | No Data | No Data | 1000 |

**Table I.3: Liquid Concentrate Formulations: Non-Agricultural Non-ULV Applications Dermal Risks**
**Summary of Malathion Occupational Handler Short- / Intermediate-Term Dermal Risks**

| Exposure Scenario | Use Site | App. Rate[c] (lb ai/A or /Gal) | Amount Handled Per Day[d] (A, Sq Ft or Gal) | Level of Personal Protective Equipment for Dermal Exposures Dermal MOE[a] – LOC[b] = 1000 | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | | | Baseline[e] | SL/GL[f] | DL/GL[g] | SL/GL/CRH[h] | DL/GL/CRH[i] | Eng. Controls[j] |
| **Loaders** | | | | | | | | | |
| Loading to Support Power Duster Applications (using WP data) | Stored Grain (barley, corn, oats, rye, wheat) being loaded into storage | 0.00062 lb ai/sq ft | 6000 sq ft | 400 | 8700 | 11000 | No Data | No Data | 150000 |
| | Stored Grain (barley, corn, oats, rye, wheat) | 0.00031 lb ai/sq ft | 6000 sq ft | 800 | 17000 | 23000 | No Data | No Data | 300000 |
| **Applicators** | | | | | | | | | |
| Aerial Applications | Agricultural Uncultivated Areas | 1 lb ai/acre | 350 A | No Data | No Data | No Data | No Data | No Data | 7500 |
| | Non-Agricultural Uncultivated Areas/Soils | 0.6 lb ai/acre | 350 A | No Data | No Data | No Data | No Data | No Data | 13000 |
| | Intermittently Flooded Areas, Swamps/ Marshes/ Stagnant Water | 0.51 lb ai/acre | 350 A | No Data | No Data | No Data | No Data | No Data | 15000 |
| Groundboom Applications | Agricultural Uncultivated Areas | 1 lb ai/acre | 200 A | 350 | 1700 | 2200 | No Data | No Data | 5400 |
| | Non-Agricultural Uncultivated Areas/Soils | 0.6 lb ai/acre | 80 A | 1500 | 7100 | 9100 | No Data | No Data | 23000 |
| Truck-Mounted Fogger Applications (airblast data) | Intermittently Flooded Areas, Swamps/ Marshes/ Stagnant Water | 0.51 lb ai/acre | 200 A | 31 | 34 | 37 | 250 | 380 | 3700 |
| Mechanically Pressurized Handgun Applications | Fence Rows/Hedge Rows | 10.45 lb ai/acre | 60 A | 6.8 | 23 | 30 | No Data | No Data | No Data |
| Power Duster Applications | Stored Grain (barley, corn, oats, rye, wheat) being loaded into storage | 0.00062 lb ai/sq ft | 6000 sq ft | No Data | No Data | No Data | No Data | No Data | No Data |
| | Stored Grain (barley, corn, oats, rye, wheat) | 0.00031 lb ai/sq ft | 6000 sq ft | No Data | No Data | No Data | No Data | No Data | No Data |

**Table I.3: Liquid Concentrate Formulations: Non-Agricultural Non-ULV Applications Dermal Risks**
**Summary of Malathion Occupational Handler Short- / Intermediate-Term Dermal Risks**

| Exposure Scenario | Use Site | App. Rate[c] (lb ai/A or /Gal) | Amount Handled Per Day[d] (A, Sq Ft or Gal) | Level of Personal Protective Equipment for Dermal Exposures Dermal MOE[a] – LOC[b] = 1000 | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | | | Baseline[e] | SL/GL[f] | DL/GL[g] | SL/GL/CRH[h] | DL/GL/CRH[i] | Eng. Controls[j] |
| **Flaggers** | | | | | | | | | |
| Flagging to Support Aerial Applications | Agricultural Uncultivated Areas | 1 lb ai/acre | 350 A | 1400 | 1300 | 1500 | No Data | No Data | No Data |
| | Non-Agricultural Uncultivated Areas/Soils | 0.6 lb ai/acre | 350 A | 2400 | 2200 | 2500 | No Data | No Data | No Data |
| | Intermittently Flooded Areas, Swamps/ Marshes/ Stagnant Water | 0.51 lb ai/acre | 350 A | 2800 | 2600 | 2900 | No Data | No Data | No Data |
| **Mixer/Loader/Applicators** | | | | | | | | | |
| Mixing/Loading/ Applying with Backpack Equipment | Cull Piles | 299 lb ai/acre | 0.5 A | 0.63 | 1.2 | 2.2 | No Data | No Data | No Data |
| | Household/Domestic Dwellings (perimeter outdoors only) | 10.45 lb ai/acre | 0.5 A | 130 | 130 | 260 | No Data | No Data | No Data |
| | Refuse/Solid Waste Containers (outdoors) | 10.45 lb ai/acre | 0.5 A | 18 | 35 | 63 | No Data | No Data | No Data |
| | Refuse/Solid Waste Sites (outdoors) | 10.45 lb ai/acre | 5 A | 1.8 | 3.5 | 6.3 | No Data | No Data | No Data |
| | Agricultural Uncultivated Areas (broadcast) | 1 lb ai/acre | 5 A | 19 | 36 | 66 | No Data | No Data | No Data |
| | Agricultural Uncultivated Areas (ground-directed) | 1 lb ai/acre | 5 A | 130 | 130 | 270 | No Data | No Data | No Data |
| | Non-Agricultural Uncultivated Areas/Soils (broadcast) | 0.6 lb ai/acre | 5 A | 31 | 60 | 110 | No Data | No Data | No Data |
| | Non-Agricultural Uncultivated Areas/Soils (ground-directed) | 0.6 lb ai/acre | 5 A | 220 | 220 | 440 | No Data | No Data | No Data |

**Table I.3: Liquid Concentrate Formulations: Non-Agricultural Non-ULV Applications Dermal Risks**
**Summary of Malathion Occupational Handler Short- / Intermediate-Term Dermal Risks**

| Exposure Scenario | Use Site | App. Rate[c] (lb ai/A or /Gal) | Amount Handled Per Day[d] (A, Sq Ft or Gal) | Level of Personal Protective Equipment for Dermal Exposures Dermal MOE[a] – LOC[b] = 1000 | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | | | Baseline[e] | SL/GL[f] | DL/GL[g] | SL/GL/CRH[h] | DL/GL/CRH[i] | Eng. Controls[j] |
| Mixing/Loading/ Applying with Backpack Equipment | Intermittently Flooded Areas, Swamps/ Marshes/ Stagnant Water (broadcast) | 0.51 lb ai/acre | 5 A | 37 | 71 | 130 | No Data | No Data | No Data |
| | Intermittently Flooded Areas, Swamps/ Marshes/ Stagnant Water (ground-directed)\ | 0.51 lb ai/acre | 5 A | 260 | 260 | 530 | No Data | No Data | No Data |
| | Grain/Cereal/Flour Bins and Elevators (empty) | 0.2 lb ai/gallon | 40 G | 12 | 23 | 41 | No Data | No Data | No Data |
| Mixing/Loading/ Applying with Manually-Pressurized Handwand Equipment | Cull Piles | 299 lb ai/acre | 0.5 A | 0.37 | 86 | 100 | No Data | No Data | No Data |
| | Household/Domestic Dwellings (perimeter outdoors only) | 10.45 lb ai/acre | 0.5 A | 11 | 2500 | 2900 | No Data | No Data | No Data |
| | Refuse/Solid Waste Containers (outdoors) | 10.45 lb ai/acre | 0.5 A | 11 | 2500 | 2900 | No Data | No Data | No Data |
| | Refuse/Solid Waste Sites (outdoors) | 10.45 lb ai/acre | 5 A | 1.1 | 250 | 290 | No Data | No Data | No Data |
| | Agricultural Uncultivated Areas | 1 lb ai/acre | 5 A | 11 | 2600 | 3000 | No Data | No Data | No Data |
| | Non-Agricultural Uncultivated Areas/Soils | 0.6 lb ai/acre | 5 A | 18 | 4300 | 5000 | No Data | No Data | No Data |
| | Intermittently Flooded Areas, Swamps/ Marshes/ Stagnant Water | 0.51 lb ai/acre | 5 A | 22 | 5000 | 5900 | No Data | No Data | No Data |

**Table I.3: Liquid Concentrate Formulations: Non-Agricultural Non-ULV Applications Dermal Risks**
**Summary of Malathion Occupational Handler Short- / Intermediate-Term Dermal Risks**

| Exposure Scenario | Use Site | App. Rate[c] (lb ai/A or /Gal) | Amount Handled Per Day[d] (A, Sq Ft or Gal) | Level of Personal Protective Equipment for Dermal Exposures Dermal MOE[a] – LOC[b] = 1000 | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | | | Baseline[e] | SL/GL[f] | DL/GL[g] | SL/GL/CRH[h] | DL/GL/CRH[i] | Eng. Controls[j] |
| Mixing/Loading/ Applying with Mechanically-Pressurized Handgun Equipment (broadcast or ground-directed) | Grain/Cereal/Flour Bins and Elevators (empty) | 0.2 lb ai/gallon | 40 G | 6.9 | 1600 | 1900 | No Data | No Data | No Data |
| | Cull Piles | 299 lb ai/acre | 0.5 A | 6.1 | 18 | 27 | No Data | No Data | No Data |
| | Household/Domestic Dwellings (perimeter outdoors only) | 10.45 lb ai/acre | 0.5 A | 170 | 520 | 780 | No Data | No Data | No Data |
| | Refuse/Solid Waste Containers (outdoors) | 10.45 lb ai/acre | 0.5 A | 170 | 520 | 780 | No Data | No Data | No Data |
| | Refuse/Solid Waste Sites (outdoors) | 10.45 lb ai/acre | 5 A | 17 | 52 | 78 | No Data | No Data | No Data |
| Mixing/Loading/ Applying with Mechanically-Pressurized Handgun Equipment (broadcast or ground-directed) | Agricultural Uncultivated Areas | 1 lb ai/acre | 40 A | 23 | 67 | 100 | No Data | No Data | No Data |
| | Non-Agricultural Uncultivated Areas/Soils | 0.6 lb ai/acre | 40 A | 38 | 110 | 170 | No Data | No Data | No Data |
| | Intermittently Flooded Areas, Swamps/ Marshes/ Stagnant Water | 0.51 lb ai/acre | 40 A | 45 | 130 | 200 | No Data | No Data | No Data |
| | Grain/Cereal/Flour Bins and Elevators (empty) | 0.2 lb ai/gallon | 1000 G | 4.6 | 13 | 20 | No Data | No Data | No Data |

a MOE = margin of exposure = Dermal Point of Departure (80 mg/kg/day) / Dermal Dose (mg/kg/day); where dermal dose = daily unit exposure (mg/lb ai) x application rate x amount handled per day x 100% dermal absorption (route-specific PoD) / bodyweight (69 kg average female adult).
b LOC = level of concern = 1000.
c Application rates are the maximum application rates determined from EPA registered labels for malathion.
d Amount handled per day values are HED estimates of acres treated per day or gallons applied per day based on industry sources and HED estimates.
e Baseline = long-sleeve shirt, long pants, shoes, socks, and no gloves .
f SL/GL = long-sleeve shirt, long pants, shoes, socks, and chemical-resistant gloves.
g DL/GL = coveralls worn over long-sleeve shirt, long pants, chemical-resistant footwear, socks, and chemical-resistant gloves.

h SL/GL/CRH = long-sleeve shirt, long pants, shoes, socks, chemical-resistant gloves, and chemical-resistant headgear.
i DL/GL/CRH = coveralls worn over long-sleeve shirt, long pants, chemical-resistant footwear, socks, chemical-resistant gloves, and chemical-resistant headgear.
j Eng. Control = Engineering control including closed mixing/loading system, enclosed cab, or enclosed cockpit.

**Table I.4: Liquid Concentrate Formulations: Non-Agricultural Non-ULV Applications Inhalation Risks**
**Summary of Malathion Occupational Handler Short / Intermediate-Term Inhalation Risks**

| Exposure Scenario | Use Site | App. Rate[c] (lb ai/A or lb ai/Gal) | Amount Handled Per Day[d] (A or Gal) | Level of Personal Protective Equipment for Inhalation Exposures Inhalation MOE[a] – LOC[b] = 3000 | | | |
|---|---|---|---|---|---|---|---|
| | | | | Baseline No-R[e] | PF5-R[f] | PF10-R[g] | Eng. Controls[h] |
| **Mixer/Loaders** | | | | | | | |
| Mixing/Loading to Support Aerial Applications | Agricultural Uncultivated Areas | 1 lb ai/acre | 350 acres | 3400 | 17000 | 34000 | 8900 |
| | Non-Agricultural Uncultivated Areas/Soils | 0.6 lb ai/acre | 350 acres | 5600 | 28000 | 56000 | 15000 |
| | Intermittently Flooded Areas, Swamps/ Marshes/ Stagnant Water | 0.51 lb ai/acre | 350 acres | 6600 | 33000 | 66000 | 17000 |
| Mixing/Loading to Support Groundboom Applications | Agricultural Uncultivated Areas | 1 lb ai/acre | 80 acres | 15000 | 74000 | 150000 | 39000 |
| | Non-Agricultural Uncultivated Areas/Soils | 0.6 lb ai/acre | 80 acres | 25000 | 120000 | 250000 | 65000 |
| Mixing/Loading to Support Truck-Mounted Fogger Applications | Intermittently Flooded Areas, Swamps/ Marshes/ Stagnant Water | 0.51 lb ai/acre | 200 acres | 25000 | 120000 | 250000 | 65000 |
| Mixing/Loading to Support Mechanically Pressurized Handgun Applications | Fence Rows/Hedge Rows | 10.45 lb ai/acre | 60 acres | 1900 | 9400 | 19000 | 5000 |
| **Loaders** | | | | | | | |
| Loading to Support Power Duster Applications (using WP data) | Stored Grain (barley, corn, oats, rye, wheat) being loaded into storage | 0.00062 lb ai/sq ft | 6000 sq ft | 1600 | 8100 | 16000 | 290000 |
| | Stored Grain (barley, corn, oats, rye, wheat) | 0.00031 lb ai/sq ft | 6000 sq ft | 3200 | 16000 | 32000 | 580000 |

**Table I.4: Liquid Concentrate Formulations: Non-Agricultural Non-ULV Applications Inhalation Risks**
**Summary of Malathion Occupational Handler Short / Intermediate-Term Inhalation Risks**

| Exposure Scenario | Use Site | App. Rate[c] (lb ai/A or lb ai/Gal) | Amount Handled Per Day[d] (A or Gal) | Level of Personal Protective Equipment for Inhalation Exposures Inhalation MOE[a] – LOC[b] = 3000 | | | |
|---|---|---|---|---|---|---|---|
| | | | | Baseline No-R[e] | PF5-R[f] | PF10-R[g] | Eng. Controls[h] |
| **Applicators** | | | | | | | |
| Aerial Applicators | Agricultural Uncultivated Areas | 1 lb ai/acre | 350 acres | No Data | No Data | No Data | 150000 |
| | Non-Agricultural Uncultivated Areas/Soils | 0.6 lb ai/acre | 350 acres | No Data | No Data | No Data | 250000 |
| | Intermittently Flooded Areas, Swamps/ Marshes/ Stagnant Water | 0.51 lb ai/acre | 350 acres | No Data | No Data | No Data | 290000 |
| Groundboom Applicators | Agricultural Uncultivated Areas | 1 lb ai/acre | 200 acres | 3800 | 19000 | 38000 | 30000 |
| | Non-Agricultural Uncultivated Areas/Soils | 0.6 lb ai/acre | 80 acres | 16000 | 79000 | 160000 | 130000 |
| Truck-Mounted Fogger Applications (using airblast data) | Intermittently Flooded Areas, Swamps/ Marshes/ Stagnant Water | 0.51 lb ai/acre | 200 acres | 540 | 2700 | 5400 | 37000 |
| Mechanically Pressurized Handgun Applications | Fence Rows/Hedge Rows | 10.45 lb ai/acre | 60 acres | 47 | 240 | 470 | No Data |
| Power Duster Applications | Stored Grain (barley, corn, oats, rye, wheat) being loaded into storage | 0.00062 lb ai/sq ft | 6000 sq ft | No Data | No Data | No Data | No Data |
| | Stored Grain (barley, corn, oats, rye, wheat) | 0.00031 lb ai/sq ft | 6000 sq ft | No Data | No Data | No Data | No Data |

**Table I.4: Liquid Concentrate Formulations: Non-Agricultural Non-ULV Applications Inhalation Risks**
**Summary of Malathion Occupational Handler Short / Intermediate-Term Inhalation Risks**

| Exposure Scenario | Use Site | App. Rate[c] (lb ai/A or lb ai/Gal) | Amount Handled Per Day[d] (A or Gal) | Level of Personal Protective Equipment for Inhalation Exposures Inhalation MOE[a] – LOC[b] = 3000 | | | |
|---|---|---|---|---|---|---|---|
| | | | | Baseline No-R[e] | PF5-R[f] | PF10-R[g] | Eng. Controls[h] |
| **Flaggers** | | | | | | | |
| Flagging to Support Aerial Applications | Agricultural Uncultivated Areas/Soils | 1 lb ai/acre | 350 acres | 2100 | 11000 | 21000 | No Data |
| | Non-Agricultural Uncultivated Areas/Soils | 0.6 lb ai/acre | 350 acres | 3500 | 18000 | 35000 | No Data |
| | Intermittently Flooded Areas, Swamps/ Marshes/ Stagnant Water | 0.51 lb ai/acre | 350 acres | 4100 | 21000 | 41000 | No Data |
| **Mixer/Loader/Applicators** | | | | | | | |
| Mixing/Loading/ Applying with Backpack Equipment | Cull Piles | 299 lb ai/acre | 0.5 acres | 25 | 130 | 250 | No Data |
| | Household/Domestic Dwellings (perimeter outdoors only) | 10.45 lb ai/acre | 0.5 acres | 19000 | 96000 | 190000 | No Data |
| | Refuse/Solid Waste Containers (outdoors) | 10.45 lb ai/acre | 0.5 acres | 720 | 3600 | 7200 | No Data |
| | Refuse/Solid Waste Sites (outdoors) | 10.45 lb ai/acre | 5 acres | 72 | 360 | 720 | No Data |
| | Agricultural Uncultivated Areas (broadcast app) | 1 lb ai/acre | 5 acres | 750 | 3700 | 7500 | No Data |
| | Agricultural Uncultivated Areas (ground-directed app) | 1 lb ai/acre | 5 acres | 20000 | 100000 | 200000 | No Data |
| | Non-Agricultural Uncultivated Areas/Soils (broadcast app) | 0.6 lb ai/acre | 5 acres | 1200 | 6200 | 12000 | No Data |
| | Non-Agricultural Uncultivated Areas/Soils (ground-directed app) | 0.6 lb ai/acre | 5 acres | 33000 | 170000 | 330000 | No Data |

**Table I.4: Liquid Concentrate Formulations: Non-Agricultural Non-ULV Applications Inhalation Risks**
**Summary of Malathion Occupational Handler Short / Intermediate-Term Inhalation Risks**

| Exposure Scenario | Use Site | App. Rate[c] (lb ai/A or lb ai/Gal) | Amount Handled Per Day[d] (A or Gal) | Level of Personal Protective Equipment for Inhalation Exposures Inhalation MOE[a] – LOC[b] = 3000 | | | |
|---|---|---|---|---|---|---|---|
| | | | | Baseline No-R[e] | PF5-R[f] | PF10-R[g] | Eng. Controls[h] |
| Mixing/Loading/ Applying with Backpack Equipment | Intermittently Flooded Areas, Swamps/ Marshes/ Stagnant Water (broadcast app) | 0.51 lb ai/acre | 5 acres | 1500 | 7300 | 15000 | No Data |
| | Intermittently Flooded Areas, Swamps/ Marshes/ Stagnant Water (ground-directed app) | 0.51 lb ai/acre | 5 acres | 39000 | 200000 | 390000 | No Data |
| | Grain/Cereal/Flour Bins and Elevators (empty) | 0.2 lb ai/gallon | 40 gallons | 470 | 2400 | 4700 | No Data |
| | Cull Piles | 299 lb ai/acre | 0.5 acres | 57 | 290 | 570 | No Data |
| | Household/Domestic Dwellings (perimeter outdoors only) | 10.45 lb ai/acre | 0.5 acres | 1600 | 8200 | 16000 | No Data |
| Mixing/Loading/ Applying with Manually-Pressurized Handwand Equipment | Refuse/Solid Waste Containers (outdoors) | 10.45 lb ai/acre | 0.5 acres | 1600 | 8200 | 16000 | No Data |
| | Refuse/Solid Waste Sites (outdoors) | 10.45 lb ai/acre | 5 acres | 160 | 820 | 1600 | No Data |
| | Agricultural Uncultivated Areas | 1 lb ai/acre | 5 acres | 1700 | 8600 | 17000 | No Data |
| | Non-Agricultural Uncultivated Areas/Soils | 0.6 lb ai/acre | 5 acres | 2900 | 14000 | 29000 | No Data |
| | Intermittently Flooded Areas, Swamps/ Marshes/ Stagnant Water | 0.51 lb ai/acre | 5 acres | 3400 | 17000 | 34000 | No Data |
| | Grain/Cereal/Flour Bins and Elevators (empty) | 0.2 lb ai/gallon | 40 gallons | 1100 | 5400 | 11000 | No Data |
| | Cull Piles | 299 lb ai/acre | 0.5 acres | 200 | 990 | 2000 | No Data |
| Mixing/Loading/ Applying with Mechanically-Pressurized | Household/Domestic Dwellings (perimeter outdoors only) | 10.45 lb ai/acre | 0.5 acres | 5700 | 28000 | 57000 | No Data |
| | Refuse/Solid Waste Containers (outdoors) | 10.45 lb ai/acre | 0.5 acres | 5700 | 28000 | 57000 | No Data |

**Table I.4: Liquid Concentrate Formulations: Non-Agricultural Non-ULV Applications Inhalation Risks**
**Summary of Malathion Occupational Handler Short / Intermediate-Term Inhalation Risks**

| Exposure Scenario | Use Site | App. Rate[c] (lb ai/A or lb ai/Gal) | Amount Handled Per Day[d] (A or Gal) | Level of Personal Protective Equipment for Inhalation Exposures Inhalation MOE[a] – LOC[b] = 3000 | | | |
|---|---|---|---|---|---|---|---|
| | | | | Baseline No-R[e] | PF5-R[f] | PF10-R[g] | Eng. Controls[h] |
| Handgun Equipment | Agricultural Uncultivated Areas (broadcast or ground-directed) | 1 lb ai/acre | 40 acres | 740 | 3700 | 7400 | No Data |

**Table I.4: Liquid Concentrate Formulations: Non-Agricultural Non-ULV Applications Inhalation Risks**
**Summary of Malathion Occupational Handler Short / Intermediate-Term Inhalation Risks**

| Exposure Scenario | Use Site | App. Rate[c] (lb ai/A or lb ai/Gal) | Amount Handled Per Day[d] (A or Gal) | Level of Personal Protective Equipment for Inhalation Exposures Inhalation MOE[a] – LOC[b] = 3000 | | | |
|---|---|---|---|---|---|---|---|
| | | | | Baseline No-R[e] | PF5-R[f] | PF10-R[g] | Eng. Controls[h] |
| Mixing/Loading/ Applying with Mechanically-Pressurized Handgun Equipment | Non-Agricultural Uncultivated Areas/Soils (broadcast or ground-directed) | 0.6 lb ai/acre | 40 acres | 1200 | 6200 | 12000 | No Data |
| | Intermittently Flooded Areas, Swamps/ Marshes/ Stagnant Water (broadcast or ground-directed) | 0.51 lb ai/acre | 40 acres | 1500 | 7300 | 15000 | No Data |
| | Grain/Cereal/Flour Bins and Elevators (empty) | 0.2 lb ai/gallon | 1000 gallons | 150 | 740 | 1500 | No Data |

a MOE = margin of exposure = Inhalation Point of Departure (mg/kg/day)/ Inhalation Dose (mg/kg/day); where inhalation dose = daily unit exposure (mg/lb ai) x application rate x amount handled per day x 100% inhalation absorption (route-specific PoD) / bodyweight (69 kg average female adult). The inhalation Point of Departure is 3.74 mg/kg/day.

b LOC = level of concern = 3000.

c Application rates are the maximum application rates determined from EPA registered labels for malathion.

d Amount handled per day values are HED estimates of acres treated per day or gallons applied per day based on industry sources and HED estimates.

e Baseline = no respirator.

f PF5-R = particulate filtering respirator. These respirators provide respiratory protection of 80% or higher.

g PF10-R = half-or full-face respirator with a particulate filter (N, P, or R) or powered air purifying respirator (PAPR) equipped with an HE filter. These respirators provide respiratory protection of 90% or higher

h Eng. Controls = closed mixing loading systems, enclosed cab, enclosed cockpit.

**Table I.5: Liquid Concentrate Formulations: ULV Non-Agricultural Applications Dermal Risks**
**Summary of Malathion Occupational Handler Short/Intermediate-Term Dermal Risks**

| Use Site | Unit Exposure Source | App. Rate[c] (lb ai/A) | Acres Treated Per Day[d] | Level of Personal Protective Equipment for Dermal Exposures Dermal MOE[a] – LOC[b] = 1000 | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | | | Baseline[e] | SL/GL[f] | DL/GL[h] | SL/GL/CRH[g] | DL/GL/CRH[i] | Eng. Controls[j] |
| **Mixer/Loaders to Support Aerial ULV Applications** | | | | | | | | | |
| Agricultural Fence Rows, Hedge Rows | Default | 10.6 | 7500 | Not applicable | Not applicable | Not applicable | No Data | No Data | 8.1 |
| | MRID# 466341-05 | 10.6 | 7500 | Not applicable | Not applicable | Not applicable | No Data | No Data | 30 |
| Non-Agricultural Uncultivated Areas/Soils, Non-Agricultural Rights-of-Way/Fence Rows, Pasture, Rangeland | Default | 0.93 | 7500 | Not applicable | Not applicable | Not applicable | No Data | No Data | 92 |
| | MRID# 466341-05 | 0.93 | 7500 | Not applicable | Not applicable | Not applicable | No Data | No Data | 340 |
| Wide Area Public Health (Mosquitoes, Biting and Filth Flies ) | Default | 0.23 | 7500 | 15 | 85 | 110 | No Data | No Data | 370 |
| | MRID# 466341-05 | 0.23 | 7500 | Not applicable | Not applicable | No Data | No Data | No Data | 1400 |
| Intermittently Flooded Areas | Default | 0.23 | 7500 | 15 | 85 | 110 | No Data | No Data | 370 |
| | MRID# 466341-05 | 0.23 | 7500 | Not applicable | Not applicable | Not applicable | No Data | No Data | 1400 |
| Agricultural Uncultivated Areas | Default | 0.19 | 7500 | Not applicable | Not applicable | Not applicable | No Data | No Data | 450 |
| | MRID# 466341-05 | 0.19 | 7500 | Not applicable | Not applicable | Not applicable | No Data | No Data | 1700 |
| **Mixer/Loaders to Support Ground ULV Applications** | | | | | | | | | |
| Agricultural Fence Rows, Hedge Rows | Default | 10.6 | 200 | Not applicable | Not applicable | Not applicable | No Data | No Data | 300 |
| | MRID# 466341-05 | 10.6 | 200 | Not applicable | Not applicable | Not applicable | No Data | No Data | 1100 |
| Non-Agricultural Uncultivated Areas/Soils, Non-Agricultural Rights-of-Way/Fence Rows, Pasture, Rangeland | Default | 0.93 | 200 | Not applicable | Not applicable | Not applicable | No Data | No Data | 3400 |
| | MRID# 466341-05 | 0.93 | 200 | Not applicable | Not applicable | Not applicable | No Data | No Data | 13000 |
| Wide Area Public Health (Mosquitoes, Biting and Filth Flies ) | Default | 0.23 | 3000 | 36 | 210 | 270 | No Data | No Data | 930 |
| | MRID# 466341-05 | 0.23 | 3000 | Not applicable | Not applicable | Not applicable | No Data | No Data | 3400 |
| Intermittently Flooded Areas | Default | 0.23 | 3000 | 36 | 210 | 270 | | No Data | 930 |
| | MRID# 466341-05 | 0.23 | 3000 | Not applicable | Not applicable | Not applicable | No Data | No Data | 3400 |
| Agricultural Uncultivated Areas | Default | 0.19 | 200 | Not applicable | Not applicable | Not applicable | No Data | No Data | 17000 |
| | MRID# 466341-05 | 0.19 | 200 | Not applicable | Not applicable | Not applicable | No Data | No Data | 63000 |

**Table I.5: Liquid Concentrate Formulations: ULV Non-Agricultural Applications Dermal Risks**
**Summary of Malathion Occupational Handler Short/Intermediate-Term Dermal Risks**

| Use Site | Unit Exposure Source | App. Rate[c] (lb ai/A) | Acres Treated Per Day[d] | Level of Personal Protective Equipment for Dermal Exposures Dermal MOE[a] – LOC[b] = 1000 | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | | | Baseline[e] | SL/GL[f] | DL/GL[h] | SL/GL/CRH[g] | DL/GL/CRH[i] | Eng. Controls[j] |
| **ULV Aerial Applicators** | | | | | | | | | |
| Agricultural Fence Rows, Hedge Rows | Default | 10.6 | 7500 | No Data | No Data | No Data | No Data | No Data | 33 |
| | MRID# 466341-05 | 10.6 | 7500 | No Data | No Data | No Data | No Data | No Data | 55 |
| Non-Agricultural Uncultivated Areas/Soils, Non-Agricultural Rights-of-Way/Fence Rows, Pasture, Rangeland | Default | 0.93 | 7500 | No Data | No Data | No Data | No Data | No Data | 380 |
| | MRID# 466341-05 | 0.93 | 7500 | No Data | No Data | No Data | No Data | No Data | 630 |
| Wide Area Public Health (Mosquitoes, Biting and Filth Flies) | Default | 0.23 | 7500 | No Data | No Data | No Data | No Data | No Data | 1500 |
| | MRID# 466341-05 | 0.23 | 7500 | No Data | No Data | No Data | No Data | No Data | 2500 |
| Intermittently Flooded Areas | Default | 0.23 | 7500 | No Data | No Data | No Data | No Data | No Data | 1500 |
| | MRID# 466341-05 | 0.23 | 7500 | No Data | No Data | No Data | No Data | No Data | 2500 |
| Agricultural Uncultivated Areas | Default | 0.19 | 200 | No Data | No Data | No Data | No Data | No Data | 70000 |
| | MRID# 466341-05 | 0.19 | 200 | No Data | No Data | No Data | No Data | No Data | 110000 |
| **ULV Ground Applicators** | | | | | | | | | |
| Agricultural Fence Rows, Hedge Rows | Airblast Default | 10.6 | 200 | 1.5 | 1.6 | 1.8 | 12 | 18 | 180 |
| Non-Agricultural Uncultivated Areas/Soils, Non-Agricultural Rights-of-Way/Fence Rows, Pasture, Rangeland | Airblast Default | 0.93 | 200 | 17 | 19 | 20 | 140 | 210 | 2000 |
| Wide Area Public Health (Mosquitoes, Biting and Filth Flies) | Airblast Default | 0.23 | 3000 | 4.5 | 5 | 5.4 | 37 | 57 | 550 |
| Intermittently Flooded Areas | Airblast Default | 0.23 | 3000 | 4.5 | 5 | 5.4 | 37 | 57 | 550 |
| Agricultural Uncultivated Areas | Airblast Default | 0.19 | 200 | 82 | 91 | 98 | 680 | 1000 | 10000 |

a MOE = margin of exposure = Dermal Point of Departure (80 mg/kg/day) / Dermal Dose (mg/kg/day); where dermal dose = daily unit exposure (mg/lb ai) x application rate (lb ai/A) x acres treated per day (A) x 100% dermal absorption (route-specific PoD) / bodyweight (69 kg average female adult).

b LOC = level of concern = 1000.
c Application rates are the maximum application rates determined from EPA registered labels for malathion.
d Acres treated per day values are HED estimates of acres treated per day based on industry sources and HED estimates.
e Baseline = long-sleeve shirt, long pants, shoes, socks, and no gloves .
f SL/GL = long-sleeve shirt, long pants, shoes, socks, and chemical-resistant gloves.
g DL/GL = coveralls worn over long-sleeve shirt, long pants, chemical-resistant footwear, socks, and chemical-resistant gloves.
h SL/GL/CRH = = long-sleeve shirt, long pants, shoes, socks, chemical-resistant gloves, and chemical-resistant headgear.
i DL/GL/CRH = coveralls worn over long-sleeve shirt, long pants, chemical-resistant footwear, socks, chemical-resistant gloves, and chemical-resistant headgear.
j Eng. Control = Engineering control including closed mixing/loading system, enclosed cab, or enclosed cockpit.

**Table I.6: Liquid Concentrate Formulations: ULV Non-Agricultural Applications Inhalation Risks**
**Summary of Malathion Occupational Handler Short / Intermediate-Term Inhalation Risks**

| Use Site | Unit Exposure Source | App. Rate[c] (lb ai/A) | Area Treated Per Day[d] (acres) | Level of Personal Protective Equipment for Inhalation Inhalation MOE[a] – LOC[b] = 3000 | | | |
|---|---|---|---|---|---|---|---|
| | | | | Baseline No-R[e] | PF5-R[f] | PF10-R[g] | Eng. Controls[h] |
| **Mixer/Loaders to Support Aerial ULV Applications** | | | | | | | |
| Agricultural Fence Rows, Hedge Rows | Default | 10.6 | 7500 | Not applicable | Not applicable | Not applicable | 39 |
| | MRID# 466341-05 | 10.6 | 7500 | No Data | No Data | No Data | 390 |
| Non-Agricultural Uncultivated Areas/Soils, Non-Agricultural Rights-of-Way/Fence Rows, Pasture, Rangeland | Default | 0.93 | 7500 | Not applicable | Not applicable | Not applicable | 450 |
| | MRID# 466341-05 | 0.93 | 7500 | No Data | No Data | No Data | 4500 |
| Wide Area Public Health (Mosquitoes, Biting and Filth Flies ) | Default | 0.23 | 7500 | 680 | 3400 | 6800 | 1800 |
| | MRID# 466341-05 | 0.23 | 7500 | No Data | No Data | No Data | 18000 |
| Intermittently Flooded Areas | Default | 0.23 | 7500 | 680 | 3400 | 6800 | 1800 |
| | MRID# 466341-05 | 0.23 | 7500 | No Data | No Data | No Data | 18000 |
| Agricultural Uncultivated Areas | Default | 0.19 | 7500 | Not applicable | Not applicable | Not applicable | 2200 |
| | MRID# 466341-05 | 0.19 | 7500 | No Data | No Data | No Data | 22000 |
| **Mixer/Loaders to Support Ground ULV Applications** | | | | | | | |
| Agricultural Fence Rows, Hedge Rows | Default | 10.6 | 200 | Not applicable | Not applicable | Not applicable | 1500 |
| | MRID# 466341-05 | 10.6 | 200 | No Data | No Data | No Data | 15000 |
| Non-Agricultural Uncultivated Areas/Soils, Non-Agricultural Rights-of-Way/Fence Rows, Pasture, Rangeland | Default | 0.93 | 200 | Not applicable | Not applicable | Not applicable | 17000 |
| | MRID# 466341-05 | 0.93 | 200 | No Data | No Data | No Data | 170000 |
| Wide Area Public Health (Mosquitoes, Biting and Filth Flies) | Default | 0.23 | 3000 | 1700 | 8500 | 17000 | 4500 |
| | MRID# 466341-05 | 0.23 | 3000 | No Data | No Data | No Data | 45000 |
| Intermittently Flooded Areas | Default | 0.23 | 3000 | 1700 | 8500 | 17000 | 4500 |
| | MRID# 466341-05 | 0.23 | 3000 | No Data | No Data | No Data | 45000 |
| | Default | 0.19 | 200 | Not applicable | Not applicable | Not applicable | 82000 |

**Table I.6: Liquid Concentrate Formulations: ULV Non-Agricultural Applications Inhalation Risks**
**Summary of Malathion Occupational Handler Short / Intermediate-Term Inhalation Risks**

| Use Site | Unit Exposure Source | App. Rate[c] (lb ai/A) | Area Treated Per Day[d] (acres) | Level of Personal Protective Equipment for Inhalation Inhalation MOE[a] – LOC[b] = 3000 | | | |
|---|---|---|---|---|---|---|---|
| | | | | Baseline No-R[e] | PF5-R[f] | PF10-R[g] | Eng. Controls[h] |
| Agricultural Uncultivated Areas | MRID# 466341-05 | 0.19 | 200 | No Data | No Data | No Data | 820000 |
| **ULV Aerial Applicators** | | | | | | | |
| Agricultural Fence Rows, Hedge Rows | Default | 10.6 | 7500 | No Data | No Data | No Data | 660 |
| | MRID# 466341-05 | 10.6 | 7500 | No Data | No Data | No Data | 240 |
| Non-Agricultural Uncultivated Areas/Soils, Non-Agricultural Rights-of-Way/Fence Rows, Pasture, Rangeland | Default | 0.93 | 7500 | No Data | No Data | No Data | 7500 |
| | MRID# 466341-05 | 0.93 | 7500 | No Data | No Data | No Data | 2700 |
| Wide Area Public Health (Mosquitoes, Biting and Filth Flies) | Default | 0.23 | 7500 | No Data | No Data | No Data | 31000 |
| | MRID# 466341-05 | 0.23 | 7500 | No Data | No Data | No Data | 11000 |
| Intermittently Flooded Areas | Default | 0.23 | 7500 | No Data | No Data | No Data | 31000 |
| | MRID# 466341-05 | 0.23 | 7500 | No Data | No Data | No Data | 11000 |
| Agricultural Uncultivated Areas | Default | 0.19 | 200 | No Data | No Data | No Data | 1400000 |
| | MRID# 466341-05 | 0.19 | 200 | No Data | No Data | No Data | 500000 |
| **ULV Ground Applicators** | | | | | | | |
| Agricultural Fence Rows, Hedge Rows | Airblast as default | 10.6 | 200 | 26 | 130 | 260 | 1800 |
| Non-Agricultural Uncultivated Areas/Soils, Non-Agricultural Rights-of-Way/Fence Rows, Pasture, Rangeland | Airblast as default | 0.93 | 200 | 290 | 1500 | 2900 | 20000 |
| Wide Area Public Health (Mosquitoes, Biting and Filth Flies) | Airblast as default | 0.23 | 3000 | 79 | 400 | 790 | 5500 |
| Intermittently Flooded Areas | Airblast as default | 0.23 | 3000 | 79 | 400 | 790 | 5500 |

**Table I.6: Liquid Concentrate Formulations: ULV Non-Agricultural Applications Inhalation Risks**
**Summary of Malathion Occupational Handler Short / Intermediate-Term Inhalation Risks**

| Use Site | Unit Exposure Source | App. Rate[c] (lb ai/A) | Area Treated Per Day[d] (acres) | Level of Personal Protective Equipment for Inhalation Inhalation MOE[a] – LOC[b] = 3000 | | | |
|---|---|---|---|---|---|---|---|
| | | | | Baseline No-R[e] | PF5-R[f] | PF10-R[g] | Eng. Controls[h] |
| Agricultural Uncultivated Areas | Airblast as default | 0.19 | 200 | 1400 | 7200 | 14000 | 100000 |

a MOE = margin of exposure = Inhalation Point of Departure (mg/kg/day)/ Inhalation Dose (mg/kg/day); where inhalation dose = daily unit exposure (mg/lb ai) x application rate x amount handled per day x 100% inhalation absorption (route-specific PoD) / bodyweight (69 kg average female adult). The inhalation Point of Departure is 3.74 mg/kg/day.

b LOC = level of concern = 3000.

c Application rates are the maximum application rates determined from EPA registered labels for malathion.

d Area treated per day values are HED estimates of acres treated per day based on industry sources and HED estimates.

e Baseline = no respirator.

f PF5-R = particulate filtering respirator. These respirators provide respiratory protection of 80% or higher.

g PF10-R = half-or full-face respirator with a particulate filter (N, P, or R) or powered air purifying respirator (PAPR) equipped with an HE filter. These respirators provide respiratory protection of 90% or higher.

h Eng. Controls = closed loading systems or enclosed cab or enclosed cockpit.

**Table I.7: Liquid Concentrate Formulations: ULV Agricultural Applications Dermal Risks**
**Summary of Malathion Occupational Handler Short / Intermediate-Term Dermal Risks**

| Crop | Unit Exposure Source | App. Rate[c] (lb ai/A) | Acres Treated Per Day[d] | Level of Personal Protective Equipment for Dermal Exposures Dermal MOE[a] – LOC[b] = 1000 | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | | | Baseline[e] | SL/GL[f] | DL/GL[g] | SL/GL/CRH[h] | DL/GL/CRH[i] | Eng. Controls[j] |
| **Mixer/Loaders to Support Aerial ULV Applications** | | | | | | | | | |
| Cherry (Sweet and Tart) | Default | 1.22 | 7500 | Not applicable | Not applicable | Not applicable | No Data | No Data | 70 |
| | MRID# 466341-05 | 1.22 | 7500 | No Data | No Data | No Data | No Data | No Data | 260 |
| Cotton | Default | 1.22 | 7500 | Not applicable | Not applicable | Not applicable | No Data | No Data | 70 |
| | MRID# 466341-05 | 1.22 | 7500 | No Data | No Data | No Data | No Data | No Data | 260 |
| Pine Seed Orchards, Christmas Tree Plantations | Default | 0.94 | 7500 | Not applicable | Not applicable | Not applicable | No Data | No Data | 91 |
| | MRID# 466341-05 | 0.94 | 7500 | No Data | No Data | No Data | No Data | No Data | 340 |
| Blueberry (highbush) | Default | 0.77 | 7500 | Not applicable | Not applicable | Not applicable | No Data | No Data | 130 |
| | MRID# 466341-05 | 0.77 | 7500 | No Data | No Data | No Data | No Data | No Data | 410 |
| Blueberry (lowbush) | Default | 0.77 | 7500 | Not applicable | Not applicable | Not applicable | No Data | No Data | 110 |
| | MRID# 466341-05 | 0.77 | 7500 | No Data | No Data | No Data | No Data | No Data | 410 |
| Alfalfa, Birdsfoot Trefoil, Clover | Default | 0.61 | 7500 | Not applicable | Not applicable | Not applicable | No Data | No Data | 140 |
| | MRID# 466341-05 | 0.61 | 7500 | No Data | No Data | No Data | No Data | No Data | 520 |
| Barley, Oats, Rice, Rye, Spring Wheat, Winter Wheat, Wild Rice | Default | 0.61 | 7500 | Not applicable | Not applicable | Not applicable | No Data | No Data | 140 |
| | MRID# 466341-05 | 0.61 | 7500 | No Data | No Data | No Data | No Data | No Data | 520 |
| Beans (dry) | Default | 0.61 | 7500 | Not applicable | Not applicable | Not applicable | No Data | No Data | 140 |
| | MRID# 466341-05 | 0.61 | 7500 | No Data | No Data | No Data | No Data | No Data | 520 |
| Beans (succulent, snap, lima) | Default | 0.61 | 7500 | Not applicable | Not applicable | Not applicable | No Data | No Data | 140 |
| | MRID# 466341-05 | 0.61 | 7500 | No Data | No Data | No Data | No Data | No Data | 520 |
| Corn (field), Sorghum | Default | 0.61 | 7500 | Not applicable | Not applicable | Not applicable | No Data | No Data | 140 |
| | MRID# 466341-05 | 0.61 | 7500 | No Data | No Data | No Data | No Data | No Data | 520 |
| Corn (pop and sweet) | Default | 0.61 | 7500 | Not applicable | Not applicable | Not applicable | No Data | No Data | 140 |
| | MRID# 466341-05 | 0.61 | 7500 | No Data | No Data | No Data | No Data | No Data | 520 |
| Lespedeza, Lupine (seed), Vetch | Default | 0.61 | 7500 | Not applicable | Not applicable | Not applicable | No Data | No Data | 140 |
| | MRID# 466341-05 | 0.61 | 7500 | No Data | No Data | No Data | No Data | No Data | 520 |
| Grapefruit, Lemon, Lime, Orange, Tangelo, Tangerine | Default | 0.18 | 7500 | Not applicable | Not applicable | Not applicable | No Data | No Data | 480 |
| | MRID# 466341-05 | 0.18 | 7500 | No Data | No Data | No Data | No Data | No Data | 1800 |
| Kumquat | Default | 0.18 | 7500 | Not applicable | Not applicable | Not applicable | No Data | No Data | 480 |

**Table I.7: Liquid Concentrate Formulations: ULV Agricultural Applications Dermal Risks**
**Summary of Malathion Occupational Handler Short / Intermediate-Term Dermal Risks**

| Crop | Unit Exposure Source | App. Rate[c] (lb ai/A) | Acres Treated Per Day[d] | Level of Personal Protective Equipment for Dermal Exposures Dermal MOE[a] – LOC[b] = 1000 | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | | | Baseline[e] | SL/GL[f] | DL/GL[g] | SL/GL/CRH[h] | DL/GL/CRH[i] | Eng. Controls[j] |
| | MRID# 466341-05 | 0.18 | 7500 | No Data | No Data | No Data | No Data | No Data | 1800 |
| **Mixer/Loaders to Support Ground ULV Applications** | | | | | | | | | |
| Cotton | Default | 1.22 | 200 | Not applicable | Not applicable | Not applicable | No Data | No Data | 2600 |
| | MRID# 466341-05 | 1.22 | 200 | No Data | No Data | No Data | No Data | No Data | 9700 |
| Pine Seed Orchards, Christmas Tree Plantations | Default | 0.94 | 200 | Not applicable | Not applicable | Not applicable | No Data | No Data | 3400 |
| | MRID# 466341-05 | 0.94 | 200 | No Data | No Data | No Data | No Data | No Data | 13000 |
| Blueberry (highbush) | Default | 0.77 | 80 | Not applicable | Not applicable | Not applicable | No Data | No Data | 10000 |
| | MRID# 466341-05 | 0.77 | 80 | No Data | No Data | No Data | No Data | No Data | 38000 |
| Blueberry (lowbush) | Default | 0.77 | 80 | Not applicable | Not applicable | Not applicable | No Data | No Data | 10000 |
| | MRID# 466341-05 | 0.77 | 80 | No Data | No Data | No Data | No Data | No Data | 38000 |
| Alfalfa, Birdsfoot Trefoil, Clover | Default | 0.61 | 200 | Not applicable | Not applicable | Not applicable | No Data | No Data | 5300 |
| | MRID# 466341-05 | 0.61 | 200 | No Data | No Data | No Data | No Data | No Data | 19000 |
| Barley, Oats, Rice, Rye, Spring Wheat, Winter Wheat, Wild Rice | Default | 0.61 | 200 | Not applicable | Not applicable | Not applicable | No Data | No Data | 5300 |
| | MRID# 466341-05 | 0.61 | 200 | No Data | No Data | No Data | No Data | No Data | 19000 |
| Beans (dry) | Default | 0.61 | 1200 | Not applicable | Not applicable | Not applicable | No Data | No Data | 5300 |
| | MRID# 466341-05 | 0.61 | 1200 | No Data | No Data | No Data | No Data | No Data | 19000 |
| Beans (succulent, snap, lima) | Default | 0.61 | 80 | Not applicable | Not applicable | Not applicable | No Data | No Data | 13000 |
| | MRID# 466341-05 | 0.61e | 80 | No Data | No Data | No Data | No Data | No Data | 48000 |
| Corn (field), Sorghum | Default | 0.61 | 200 | Not applicable | Not applicable | Not applicable | No Data | No Data | 5300 |
| | MRID# 466341-05 | 0.61 | 200 | No Data | No Data | No Data | No Data | No Data | 19000 |
| Corn (pop and sweet) | Default | 0.61 | 80 | Not applicable | Not applicable | Not applicable | No Data | No Data | 13000 |
| | MRID# 466341-05 | 0.61 | 80 | No Data | No Data | No Data | No Data | No Data | 48000 |
| Lespedeza, Lupine (seed), Vetch | Default | 0.61 | 200 | Not applicable | Not applicable | Not applicable | No Data | No Data | 5300 |
| | MRID# 466341-05 | 0.61 | 200 | No Data | No Data | No Data | No Data | No Data | 19000 |
| | Default | 0.18 | 80 | Not applicable | Not applicable | Not applicable | No Data | No Data | 44000 |

**Table I.7: Liquid Concentrate Formulations: ULV Agricultural Applications Dermal Risks**
**Summary of Malathion Occupational Handler Short / Intermediate-Term Dermal Risks**

| Crop | Unit Exposure Source | App. Rate[c] (lb ai/A) | Acres Treated Per Day[d] | Level of Personal Protective Equipment for Dermal Exposures Dermal MOE[a] – LOC[b] = 1000 | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | | | Baseline[e] | SL/GL[f] | DL/GL[g] | SL/GL/CRH[h] | DL/GL/CRH[i] | Eng. Controls[j] |
| Grapefruit, Lemon, Lime, Orange, Tangelo, Tangerine | MRID# 466341-05 | 0.18 | 80 | No Data | No Data | No Data | No Data | No Data | 160000 |
| Kumquat | Default | 0.18 | 80 | Not applicable | Not applicable | Not applicable | No Data | No Data | 44000 |
| | MRID# 466341-05 | 0.18 | 80 | No Data | No Data | No Data | No Data | No Data | 160000 |
| **ULV Aerial Applicators** | | | | | | | | | |
| Cherry (Sweet and Tart) | Default | 1.22 | 7500 | No Data | No Data | No Data | No Data | No Data | 290 |
| | MRID# 466341-05 | 1.22 | 7500 | No Data | No Data | No Data | No Data | No Data | 480 |
| Cotton | Default | 1.22 | 7500 | No Data | No Data | No Data | No Data | No Data | 290 |
| | MRID# 466341-05 | 1.22 | 7500 | No Data | No Data | No Data | No Data | No Data | 480 |
| Pine Seed Orchards, Christmas Tree Plantations | Default | 0.94 | 7500 | No Data | No Data | No Data | No Data | No Data | 380 |
| | MRID# 466341-05 | 0.94 | 7500 | No Data | No Data | No Data | No Data | No Data | 620 |
| Blueberry (highbush) | Default | 0.77 | 7500 | No Data | No Data | No Data | No Data | No Data | 460 |
| | MRID# 466341-05 | 0.77 | 7500 | No Data | No Data | No Data | No Data | No Data | 750 |
| Blueberry (lowbush) | Default | 0.77 | 7500 | No Data | No Data | No Data | No Data | No Data | 460 |
| | MRID# 466341-05 | 0.77 | 7500 | No Data | No Data | No Data | No Data | No Data | 750 |
| Alfalfa, Birdsfoot Trefoil, Clover | Default | 0.61 | 7500 | No Data | No Data | No Data | No Data | No Data | 580 |
| | MRID# 466341-05 | 0.61 | 7500 | No Data | No Data | No Data | No Data | No Data | 950 |
| Barley, Oats, Rice, Rye, Spring Wheat, Winter Wheat, Wild Rice | Default | 0.61 | 7500 | No Data | No Data | No Data | No Data | No Data | 580 |
| | MRID# 466341-05 | 0.61 | 7500 | No Data | No Data | No Data | No Data | No Data | 950 |
| Beans (dry) | Default | 0.61 | 7500 | No Data | No Data | No Data | No Data | No Data | 580 |
| | MRID# 466341-05 | 0.61 | 7500 | No Data | No Data | No Data | No Data | No Data | 950 |
| Beans (succulent, snap, lima) | Default | 0.61 | 7500 | No Data | No Data | No Data | No Data | No Data | 580 |
| | MRID# 466341-05 | 0.61e | 7500 | No Data | No Data | No Data | No Data | No Data | 950 |
| Corn (field), Sorghum | Default | 0.61 | 7500 | No Data | No Data | No Data | No Data | No Data | 580 |
| | MRID# 466341-05 | 0.61 | 7500 | No Data | No Data | No Data | No Data | No Data | 950 |
| Corn (pop and sweet) | Default | 0.61 | 7500 | No Data | No Data | No Data | No Data | No Data | 580 |
| | MRID# 466341-05 | 0.61 | 7500 | No Data | No Data | No Data | No Data | No Data | 950 |

**Table I.7: Liquid Concentrate Formulations: ULV Agricultural Applications Dermal Risks**
**Summary of Malathion Occupational Handler Short / Intermediate-Term Dermal Risks**

| Crop | Unit Exposure Source | App. Rate[c] (lb ai/A) | Acres Treated Per Day[d] | Level of Personal Protective Equipment for Dermal Exposures Dermal MOE[a] – LOC[b] = 1000 | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | | | Baseline[e] | SL/GL[f] | DL/GL[g] | SL/GL/CRH[h] | DL/GL/CRH[i] | Eng. Controls[j] |
| Lespedeza, Lupine (seed), Vetch | Default | 0.61 | 7500 | No Data | No Data | No Data | No Data | No Data | 580 |
| | MRID# 466341-05 | 0.61 | 7500 | No Data | No Data | No Data | No Data | No Data | 950 |

**Table I.7: Liquid Concentrate Formulations: ULV Agricultural Applications Dermal Risks**
**Summary of Malathion Occupational Handler Short / Intermediate-Term Dermal Risks**

| Crop | Unit Exposure Source | App. Rate[c] (lb ai/A) | Acres Treated Per Day[d] | Level of Personal Protective Equipment for Dermal Exposures Dermal MOE[a] – LOC[b] = 1000 | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | | | Baseline[e] | SL/GL[f] | DL/GL[g] | SL/GL/CRH[h] | DL/GL/CRH[i] | Eng. Controls[j] |
| Grapefruit, Lemon, Lime, Orange, Tangelo, Tangerine | Default | 0.18 | 7500 | No Data | No Data | No Data | No Data | No Data | 2000 |
| | MRID# 466341-05 | 0.18 | 7500 | No Data | No Data | No Data | No Data | No Data | 3200 |
| Kumquat | Default | 0.18 | 7500 | No Data | No Data | No Data | No Data | No Data | 2000 |
| | MRID# 466341-05 | 0.18 | 7500 | No Data | No Data | No Data | No Data | No Data | 3200 |
| **ULV Ground Applicators** | | | | | | | | | |
| Cotton | Airblast Default | 1.22 | 200 | 13 | 14 | 15 | 110 | 160 | 1600 |
| Pine Seed Orchards, Christmas Tree Plantations | Airblast Default | 0.94 | 200 | 17 | 18 | 20 | 140 | 210 | 2000 |
| Blueberry (highbush) | Airblast Default | 0.77 | 80 | 51 | 56 | 61 | 420 | 630 | 6200 |
| Blueberry (lowbush) | Airblast Default | 0.77 | 80 | 51 | 56 | 61 | 420 | 630 | 6200 |
| Alfalfa, Birdsfoot Trefoil, Clover | Airblast Default | 0.61 | 200 | 26 | 28 | 31 | 210 | 320 | 3100 |
| Barley, Oats, Rice, Rye, Spring Wheat, Winter Wheat, Wild Rice | Airblast Default | 0.61 | 200 | 26 | 28 | 31 | 210 | 320 | 3100 |
| Beans (dry) | Airblast Default | 0.61 | 200 | 26 | 28 | 31 | 210 | 320 | 3100 |
| Beans (succulent, snap, lima) | Airblast Default | 0.61 | 80 | 64 | 71 | 76 | 530 | 800 | 7800 |
| Corn (field), Sorghum | Airblast Default | 0.61 | 200 | 26 | 28 | 31 | 210 | 320 | 3100 |
| Corn (pop and sweet) | Airblast Default | 0.61 | 80 | 64 | 71 | 76 | 530 | 800 | 7800 |
| Lespedeza, Lupine (seed), Vetch | Airblast Default | 0.61 | 200 | 26 | 28 | 31 | 210 | 320 | 3100 |
| Grapefruit, Lemon, Lime, Orange, Tangelo, Tangerine | Airblast Default | 0.18 | 80 | 220 | 240 | 260 | 1800 | 2700 | 26000 |
| Kumquat | Airblast Default | 0.18 | 80 | 220 | 240 | 260 | 1800 | 2700 | 26000 |

a MOE = margin of exposure = Dermal Point of Departure (80 mg/kg/day) / Dermal Dose (mg/kg/day); where dermal dose = daily unit exposure (mg/lb ai) x application rate (lb ai/A) x acres treated per day (A) x 100% dermal absorption (route-specific PoD) / bodyweight (69 kg average female adult).

b LOC = level of concern = 1000.
c Application rates are the maximum application rates determined from EPA registered labels for malathion.
d Acres treated per day values are HED estimates of acres treated per day based on industry sources and HED estimates.
e Baseline = long-sleeve shirt, long pants, shoes, socks, and no gloves .
f SL/GL = long-sleeve shirt, long pants, shoes, socks, and chemical-resistant gloves.
g DL/GL = coveralls worn over long-sleeve shirt and long pants, chemical-resistant footwear, socks, and chemical-resistant gloves.
h SL/GL/CRH = long-sleeve shirt, long pants, shoes, socks, chemical-resistant gloves, and chemical-resistant headgear.
i DL/GL/CRH = coveralls worn over long-sleeve shirt and long pants, chemical-resistant footwear, socks, chemical-resistant gloves, and chemical-resistant headgear.
j Eng. Control = Engineering control including closed mixing/loading system, enclosed cab, or enclosed cockpit.

**Table I.8: Liquid Concentrate Formulations: ULV Agricultural Inhalation Risks**
**Summary of Malathion Occupational Handler Short / Intermediate-Term Inhalation Risks**

| Crop | Unit Exposure Source | App. Rate[c] (lb ai/A) | Acres Treated Per Day[d] (acres) | Level of Personal Protective Equipment for Inhalation Exposures Inhalation MOE[a] – LOC[b] = 3000 | | | |
|---|---|---|---|---|---|---|---|
| | | | | Baseline No-R[e] | PF5-R[f] | PF10-R[g] | Eng. Controls[h] |
| **Mixer/Loaders to Support Aerial ULV Applications** | | | | | | | |
| Cherry (Sweet and Tart) | Default | 1.22 | 7500 | Not applicable | Not applicable | Not applicable | 340 |
| | MRID# 466341-05 | 1.22 | 7500 | No Data | No Data | No Data | 3400 |
| Cotton | Default | 1.22 | 7500 | Not applicable | Not applicable | Not applicable | 340 |
| | MRID# 466341-05 | 1.22 | 7500 | No Data | No Data | No Data | 3400 |
| Pine Seed Orchards, Christmas Tree Plantations | Default | 0.94 | 7500 | Not applicable | Not applicable | Not applicable | 440 |
| | MRID# 466341-05 | 0.94 | 7500 | No Data | No Data | No Data | 4400 |
| Bermuda Grass | Default | 0.92 | 7500 | Not applicable | Not applicable | Not applicable | 450 |
| | MRID# 466341-05 | 0.92 | 7500 | No Data | No Data | No Data | 4500 |
| Blueberry (highbush) | Default | 0.77 | 7500 | Not applicable | Not applicable | Not applicable | 4300 |
| | MRID# 466341-05 | 0.77 | 7500 | No Data | No Data | No Data | 5400 |
| Blueberry (lowbush) | Default | 0.77 | 7500 | Not applicable | Not applicable | Not applicable | 540 |
| | MRID# 466341-05 | 0.77 | 7500 | No Data | No Data | No Data | 5400 |
| Alfalfa, Birdsfoot Trefoil, Clover | Default | 0.61 | 7500 | Not applicable | Not applicable | Not applicable | 680 |
| | MRID# 466341-05 | 0.61 | 7500 | No Data | No Data | No Data | 6800 |
| Barley, Oats, Rice, Rye, Spring Wheat, Winter Wheat, Wild Rice | Default | 0.61 | 7500 | Not applicable | Not applicable | Not applicable | 680 |
| | MRID# 466341-05 | 0.61 | 7500 | No Data | No Data | No Data | 6800 |
| Beans (dry) | Default | 0.61 | 7500 | Not applicable | Not applicable | Not applicable | 680 |
| | MRID# 466341-05 | 0.61 | 7500 | No Data | No Data | No Data | 6800 |
| Beans (succulent, snap, lima) | Default | 0.61 | 7500 | Not applicable | Not applicable | Not applicable | 680 |
| | MRID# 466341-05 | 0.61 | 7500 | No Data | No Data | No Data | 6800 |
| Corn (field), Sorghum | Default | 0.61 | 7500 | Not applicable | Not applicable | Not applicable | 680 |
| | MRID# 466341-05 | 0.61 | 7500 | No Data | No Data | No Data | 6800 |
| Corn (pop and sweet) | Default | 0.61 | 7500 | Not applicable | Not applicable | Not applicable | 680 |
| | MRID# 466341-05 | 0.61 | 7500 | No Data | No Data | No Data | 6800 |
| Lespedeza, Lupine (seed), Vetch | Default | 0.61 | 7500 | Not applicable | Not applicable | Not applicable | 680 |
| | MRID# 466341-05 | 0.61 | 7500 | No Data | No Data | No Data | 6800 |
| | Default | 0.18 | 7500 | Not applicable | Not applicable | Not applicable | 2300 |

**Table I.8: Liquid Concentrate Formulations: ULV Agricultural Inhalation Risks**
**Summary of Malathion Occupational Handler Short / Intermediate-Term Inhalation Risks**

| Crop | Unit Exposure Source | App. Rate[c] (lb ai/A) | Acres Treated Per Day[d] (acres) | Level of Personal Protective Equipment for Inhalation Exposures Inhalation MOE[a] – LOC[b] = 3000 | | | |
|---|---|---|---|---|---|---|---|
| | | | | Baseline No-R[e] | PF5-R[f] | PF10-R[g] | Eng. Controls[h] |
| Grapefruit, Lemon, Lime, Orange, Tangelo, Tangerine | MRID# 466341-05 | 0.18 | 7500 | No Data | No Data | No Data | 23000 |
| Kumquat | Default | 0.18 | 7500 | Not applicable | Not applicable | Not applicable | 2300 |
| | MRID# 466341-05 | 0.18 | 7500 | No Data | No Data | No Data | 23000 |
| **Mixer/Loaders to Support Ground ULV Applications** | | | | | | | |
| Cotton | Default | 1.22 | 200 | Not applicable | Not applicable | Not applicable | 13000 |
| | MRID# 466341-05 | 1.22 | 200 | No Data | No Data | No Data | 130000 |
| Pine Seed Orchards, Christmas Tree Plantations | Default | 0.94 | 200 | Not applicable | Not applicable | Not applicable | 17000 |
| | MRID# 466341-05 | 0.94 | 200 | No Data | No Data | No Data | 170000 |
| Bermuda Grass | Default | 0.92 | 80 | Not applicable | Not applicable | Not applicable | 42000 |
| | MRID# 466341-05 | 0.92 | 80 | No Data | No Data | No Data | 420000 |
| Blueberry (highbush) | Default | 0.77 | 80 | Not applicable | Not applicable | Not applicable | 50000 |
| | MRID# 466341-05 | 0.77 | 80 | No Data | No Data | No Data | 500000 |
| Blueberry (lowbush) | Default | 0.77 | 80 | Not applicable | Not applicable | Not applicable | 50000 |
| | MRID# 466341-05 | 0.77 | 80 | No Data | No Data | No Data | 500000 |
| Alfalfa, Birdsfoot Trefoil, Clover | Default | 0.61 | 200 | Not applicable | Not applicable | Not applicable | 26000 |
| | MRID# 466341-05 | 0.61 | 200 | No Data | No Data | No Data | 260000 |
| Barley, Oats, Rice, Rye, Spring Wheat, Winter Wheat, Wild Rice | Default | 0.61 | 200 | Not applicable | Not applicable | Not applicable | 26000 |
| | MRID# 466341-05 | 0.61 | 200 | No Data | No Data | No Data | 260000 |
| Beans (dry) | Default | 0.61 | 200 | Not applicable | Not applicable | Not applicable | 26000 |
| | MRID# 466341-05 | 0.61 | 200 | No Data | No Data | No Data | 260000 |
| Beans (succulent, snap, lima) | Default | 0.61 | 80 | Not applicable | Not applicable | Not applicable | 64000 |
| | MRID# 466341-05 | 0.61 | 80 | No Data | No Data | No Data | 640000 |
| Corn (field), Sorghum | Default | 0.61 | 200 | Not applicable | Not applicable | Not applicable | 26000 |
| | MRID# 466341-05 | 0.61 | 200 | No Data | No Data | No Data | 260000 |
| Corn (pop and sweet) | Default | 0.61 | 80 | Not applicable | Not applicable | Not applicable | 64000 |

**Table I.8: Liquid Concentrate Formulations: ULV Agricultural Inhalation Risks**
**Summary of Malathion Occupational Handler Short / Intermediate-Term Inhalation Risks**

| Crop | Unit Exposure Source | App. Rate[c] (lb ai/A) | Acres Treated Per Day[d] (acres) | Level of Personal Protective Equipment for Inhalation Exposures Inhalation MOE[a] – LOC[b] = 3000 | | | |
|---|---|---|---|---|---|---|---|
| | | | | Baseline No-R[e] | PF5-R[f] | PF10-R[g] | Eng. Controls[h] |
| Lespedeza, Lupine (seed), Vetch | MRID# 466341-05 | 0.61 | 80 | No Data | No Data | No Data | 640000 |
| | Default | 0.61 | 200 | Not applicable | Not applicable | Not applicable | 26000 |
| | MRID# 466341-05 | 0.61 | 200 | No Data | No Data | No Data | 260000 |
| Grapefruit, Lemon, Lime, Orange, Tangelo, Tangerine | Default | 0.18 | 80 | Not applicable | Not applicable | Not applicable | 210000 |
| | MRID# 466341-05 | 0.18 | 80 | No Data | No Data | No Data | 2100000 |
| Kumquat | Default | 0.18 | 80 | Not applicable | Not applicable | Not applicable | 210000 |
| | MRID# 466341-05 | 0.18 | 80 | No Data | No Data | No Data | 2100000 |
| **ULV Aerial Applicators** | | | | | | | |
| Cherry (Sweet and Tart) | Default | 1.22 | 7500 | No Data | No Data | No Data | 5800 |
| | MRID# 466341-05 | 1.22 | 7500 | No Data | No Data | No Data | 2100 |
| Cotton | Default | 1.22 | 7500 | No Data | No Data | No Data | 5800 |
| | MRID# 466341-05 | 1.22 | 7500 | No Data | No Data | No Data | 2100 |
| Pine Seed Orchards, Christmas Tree Plantations | Default | 0.94 | 7500 | No Data | No Data | No Data | 7500 |
| | MRID# 466341-05 | 0.94 | 7500 | No Data | No Data | No Data | 2700 |
| Bermuda Grass | Default | 0.92 | 7500 | No Data | No Data | No Data | 7600 |
| | MRID# 466341-05 | 0.92 | 7500 | No Data | No Data | No Data | 2800 |
| Blueberry (highbush) | Default | 0.77 | 7500 | No Data | No Data | No Data | 9100 |
| | MRID# 466341-05 | 0.77 | 7500 | No Data | No Data | No Data | 3300 |
| Blueberry (lowbush) | Default | 0.77 | 7500 | No Data | No Data | No Data | 9100 |
| | MRID# 466341-05 | 0.77 | 7500 | No Data | No Data | No Data | 3300 |
| Alfalfa, Birdsfoot Trefoil, Clover | Default | 0.61 | 7500 | No Data | No Data | No Data | 12000 |
| | MRID# 466341-05 | 0.61 | 7500 | No Data | No Data | No Data | 4200 |
| Barley, Oats, Rice, Rye, Spring Wheat, Winter Wheat, Wild Rice | Default | 0.61 | 7500 | No Data | No Data | No Data | 12000 |
| | MRID# 466341-05 | 0.61 | 7500 | No Data | No Data | No Data | 4200 |
| Beans (dry) | Default | 0.61 | 7500 | No Data | No Data | No Data | 12000 |
| | MRID# 466341-05 | 0.61 | 7500 | No Data | No Data | No Data | 4200 |

**Table I.8: Liquid Concentrate Formulations: ULV Agricultural Inhalation Risks**
**Summary of Malathion Occupational Handler Short / Intermediate-Term Inhalation Risks**

| Crop | Unit Exposure Source | App. Rate[c] (lb ai/A) | Acres Treated Per Day[d] (acres) | Level of Personal Protective Equipment for Inhalation Exposures Inhalation MOE[a] – LOC[b] = 3000 | | | |
|---|---|---|---|---|---|---|---|
| | | | | Baseline No-R[e] | PF5-R[f] | PF10-R[g] | Eng. Controls[h] |
| Beans (succulent, snap, lima) | Default | 0.61 | 7500 | No Data | No Data | No Data | 12000 |
| | MRID# 466341-05 | 0.61 | 7500 | No Data | No Data | No Data | 4200 |
| Corn (field), Sorghum | Default | 0.61 | 7500 | No Data | No Data | No Data | 12000 |
| | MRID# 466341-05 | 0.61 | 7500 | No Data | No Data | No Data | 4200 |
| Corn (pop and sweet) | Default | 0.61 | 7500 | No Data | No Data | No Data | 12000 |
| | MRID# 466341-05 | 0.61 | 7500 | No Data | No Data | No Data | 4200 |
| Lespedeza, Lupine (seed), Vetch | Default | 0.61 | 7500 | No Data | No Data | No Data | 12000 |
| | MRID# 466341-05 | 0.61 | 7500 | No Data | No Data | No Data | 4200 |
| Grapefruit, Lemon, Lime, Orange, Tangelo, Tangerine | Default | 0.18 | 7500 | No Data | No Data | No Data | 39000 |
| | MRID# 466341-05 | 0.18 | 7500 | No Data | No Data | No Data | 14000 |
| Kumquat | Default | 0.18 | 7500 | No Data | No Data | No Data | 39000 |
| | MRID# 466341-05 | 0.18 | 7500 | No Data | No Data | No Data | 14000 |
| **ULV Ground Applicators** | | | | | | | |
| Cotton | Airblast as default | 1.22 | 200 | 220 | 1100 | 2200 | 16000 |
| Pine Seed Orchards, Christmas Tree Plantations | Airblast as default | 0.94 | 200 | 290 | 1500 | 2900 | 20000 |
| Bermuda Grass | Airblast as default | 0.92 | 80 | 740 | 3700 | 7400 | 52000 |
| Blueberry (highbush) | Airblast as default | 0.77 | 80 | 890 | 4400 | 8900 | 62000 |
| Blueberry (lowbush) | Airblast as default | 0.77 | 80 | 890 | 4400 | 8900 | 62000 |
| Alfalfa, Birdsfoot Trefoil, Clover | Airblast as default | 0.61 | 200 | 450 | 2200 | 4500 | 31000 |
| Barley, Oats, Rice, Rye, Spring Wheat, Winter Wheat, Wild Rice | Airblast as default | 0.61 | 200 | 450 | 2200 | 4500 | 31000 |
| Beans (dry) | Airblast as default | 0.61 | 200 | 450 | 2200 | 4500 | 31000 |
| Beans (succulent, snap, lima) | Airblast as default | 0.61 | 80 | 1100 | 5600 | 11000 | 78000 |
| Corn (field), Sorghum | Airblast as default | 0.61 | 200 | 450 | 2200 | 4500 | 31000 |
| Corn (pop and sweet) | Airblast as default | 0.61 | 80 | 1100 | 5600 | 11000 | 78000 |
| Lespedeza, Lupine (seed), Vetch | Airblast as default | 0.61 | 200 | 450 | 2200 | 4500 | 31000 |

**Table I.8: Liquid Concentrate Formulations: ULV Agricultural Inhalation Risks**
**Summary of Malathion Occupational Handler Short / Intermediate-Term Inhalation Risks**

| Crop | Unit Exposure Source | App. Rate[c] (lb ai/A) | Acres Treated Per Day[d] (acres) | Level of Personal Protective Equipment for Inhalation Exposures Inhalation MOE[a] – LOC[b] = 3000 | | | |
|---|---|---|---|---|---|---|---|
| | | | | Baseline No-R[e] | PF5-R[f] | PF10-R[g] | Eng. Controls[h] |
| Grapefruit, Lemon, Lime, Orange, Tangelo, Tangerine | Airblast as default | 0.18 | 80 | 3800 | 19000 | 38000 | 260000 |
| Kumquat | Airblast as default | 0.18 | 80 | 3800 | 19000 | 38000 | 260000 |

a MOE = margin of exposure = Inhalation Point of Departure (mg/kg/day)/ Inhalation Dose (mg/kg/day); where inhalation dose = daily unit exposure (mg/lb ai) x application rate x amount handled per day x 100% inhalation absorption (route-specific PoD) / bodyweight (69 kg average female adult). The inhalation Point of Departure is 3.74 mg/kg/day.

b LOC = level of concern = 3000.

c Application rates are the maximum application rates determined from EPA registered labels for malathion.

d Acres treated per day values are HED estimates of acres treated per day based on industry sources and HED estimates.

e Baseline = no respirator.

f PF5-R = particulate filtering respirator. These respirators provide respiratory protection of 80% or higher.

g PF10-R = half-or full-face respirator with a particulate filter (N, P, or R) or powered air purifying respirator (PAPR) equipped with an HE filter. These respirators provide respiratory protection of 90% or higher.

h Eng. Controls = Closed mixing/loading systems, enclosed cabs, and enclosed cockpits.

## Appendix J: Summary of Occupational Post-application Risk Assessment for Malathion-Malaoxon

| Table J.1. Summary of Post-application Risk Assessment for Malathion-Malaoxon Using MRID 451382-01 Blackberry DFR Data + Oxon Estimates | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| **Crop Group** | **Use Site** | **DFR Source[a]** | **App Rate[b] lbai/A** | **Transfer Coeficient[c] ($cm^2$/hr)** | **Activity[c]** | **MOE[d] at Day 0** | **DAT when MOE>1000** | **MOE[d]** |
| BERRY: LOW | Strawberry | MRID 451382-01 | 2 | 70 | Hand Weeding; Canopy Management | 6500 | 0 | 6500 |
| | | | | 210 | Scouting | 2200 | 0 | 2200 |
| | | | | 230 | Transplanting | 2000 | 0 | 2000 |
| | | | | 1100 | Hand Harvesting | 420 | 3 | 1400 |
| | | | | NA | Irrigation (non-hand set); Mechanical Weeding | NA | NA | NA |
| BERRY: LOW | Blueberry (lowbush) | MRID 451382-01 | 1.25 | 70 | Hand Weeding | 10000 | 0 | 10000 |
| | | | | 230 | Transplanting | 3200 | 0 | 3200 |
| | | | | 1100 | Hand Harvesting; Scouting | 660 | 2 | 1500 |
| | | | | 1900 | Irrigation (hand set) | 380 | 3 | 1300 |
| | | | | NA | Irrigation (non-hand set); Mechanical Weeding; Mechanical Harvesting | NA | NA | NA |
| BERRY: LOW | Blueberry (lowbush) | MRID 451382-01 | 0.77 ULV | 70 | Hand Weeding | 1700 | 0 | 1700 |
| | | | | 230 | Transplanting | 5200 | 0 | 5200 |
| | | | | 1100 | Hand Harvesting; Scouting | 1100 | 0 | 1100 |
| | | | | 1900 | Irrigation (hand set) | 620 | 2 | 1400 |
| | | | | NA | Irrigation (non-hand set); Mechanical Weeding; Mechanical Harvesting | NA | NA | NA |
| | | | | 1400 | Hand Harvesting | 160 | 4 | 1200 |
| | | | | 3600 | Thinning Fruit | 61 | 6 | 1300 |
| | | | | Use Alternate TC Method | Hand Pruning (minimal foliage) | NA | NA | NA |
| | | | | NA | Irrigation (non-hand set); Mechanical Harvesting; Mechanical Weeding; Fertilizing; Spreading Bins | NA | NA | NA |

| Table J.1. Summary of Post-application Risk Assessment for Malathion-Malaoxon Using MRID 451382-01 Blackberry DFR Data + Oxon Estimates | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| **Crop Group** | **Use Site** | **DFR Source[a]** | **App Rate[b] lbai/A** | **Transfer Coeficient[c] ($cm^2$/hr)** | **Activity[c]** | **MOE[d] at Day 0** | **DAT when MOE>1000** | **MOE[d]** |
| VEGETABLE: STALK & STEM | Pineapple | MRID 451382-01 | 2 | 70 | Hand Weeding | 6500 | 0 | 6500 |
| | | | | 210 | Scouting | 2200 | 0 | 2200 |
| | | | | 1100 | Hand Harvesting | 420 | 4 | 1400 |
| | | | | NA | Irrigation (non-hand set) | NA | NA | NA |
| VINE/ TRELLIS | Blackberry, Raspberry, Boysenberry, Dewberry, Gooseberry, Loganberry | MRID 451382-01 | 2 | 230 | Transplanting | 2000 | 0 | 2000 |
| | | | | 640 | Scouting; Hand Pruning; Hand Weeding; Tying/Training (minimal foliage) | 710 | 1 | 1100 |
| | | | | 1400 | Hand Harvesting; Tying/Training (full foliage) | 330 | 3 | 1100 |
| | | | | 1900 | Irrigation (hand set) | 240 | 4 | 1200 |
| | | | | NA | Irrigation (non-hand set); Mechanical Harvesting; Mechanical Weeding; Burndown; Crop Control | NA | NA | NA |

**NA**: Not Available – no known transfer coefficient for this activity, therefore, MOEs could not be calculated.

a. DFR Source: ARETF Malathion DFR studies were used to calculate DFR residues for malathion. Malaoxon residues were not measured in the studies, but were estimated to be 5% of the parent. Regressions were run to provide predicted malathion-malaoxon residues after treatment. Additionally, a 22x toxicity adjustment factor was applied to the estimated malaoxon residue to account for the additional toxicity of the oxon. Regression was run based on: Estimated DFR of Malathion-Malaoxon = malathion DFR + 22 X (0.05 malathion DFR)
   - MRID 451382-01 Blackberry Study application rate = 1.9 lb ai/acre

b. Application rates are the maximum application rates determined from EPA registered labels for malathion.

c. Transfer Coefficient and Post Application Activities from EPA's Occupational Pesticide Re-entry Exposure Calculator – Revised March 2013.

d. MOE calculated using dermal dose and POD for malathion (80 mg/kg/day). Dermal Dose (mg/kg/day) = DFR (µg/$cm^2$) x 8 hr x transfer coefficient ($cm^2$/hr) / 1000 x body weight (69 kg). MOE = POD (mg/kg/day) / dermal dose (mg/kg/day. Level of Concern (LOC) = 1,000.

| Table J.2. Summary of Postapplication Risk Assessment for Malathion-Malaoxon Using MRID 454919-02 Summer Squash DFR Data + Oxon Estimates | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| **Crop Group** | **Use Site** | **DFR Source[a]** | **App Rate[b] lbai/A** | **Transfer Coeficient[c] ($cm^2$/hr)** | **Activity[c]** | **MOE[d] at Day 0** | **DAT when MOE>1000** | **MOE[d]** |
| CUT FLOWERS | Flowers, Foliage | MRID 454919-02 | 0.25 | 230 | Container Moving; Pinching; Hand Pruning; Hand Weeding: Scouting; Transplanting | 970 | 1 | 1700 |
| | | | | 1900 | Irrigation (hand set) | 120 | 4 | 1200 |
| | | | | 4800 | Hand Harvesting | 47 | 6 | 1500 |
| | | | | NA | Irrigation (non-hand set); Mechanical Weeding | NA | NA | NA |
| CUT FLOWERS | Flowers, Foliage | MRID 454919-02 | 1 | 230 | Container Moving; Pinching; Hand Pruning; Hand Weeding: Scouting; Transplanting | 240 | 3 | 1400 |
| | | | | 1900 | Irrigation (hand set) | 29 | 7 | 1800 |
| | | | | 4800 | Hand Harvesting | 12 | 8 | 1200 |
| | | | | NA | Irrigation (non-hand set); Mechanical Weeding | NA | NA | NA |
| CUT FLOWERS | Flowers, Foliage | MRID 454919-02 | 10 | 230 | Container Moving; Pinching; Hand Pruning; Hand Weeding: Scouting; Transplanting | 24 | 7 | 1400 |
| | | | | 1900 | Irrigation (hand set) | 2.9 | 10 | 1000 |
| | | | | 4800 | Hand Harvesting | 1.2 | 12 | 1300 |
| | | | | NA | Irrigation (non-hand set); Mechanical Weeding | NA | NA | NA |
| EDIBLE FUNGI | Mushroom | MRID 454919-02 | 1.7 | 400 | All Tasks | 82 | 5 | 1500 |
| FIELD & ROW CROPS: LOW to MEDIUM (Nongrass Animal Feeds) | Alfalfa, Clover, Lespedeza, Lupine, Vetch | MRID 454919-02 | 1.25 | 1100 | Scouting | 41 | 6 | 1300 |
| | | | | 1900 | Irrigation (hand set) | 24 | 7 | 1400 |
| | | | | NA | Irrigation (non-hand set); Mechanical Harvesting; Fertilizing | NA | NA | NA |
| | | | | 1100 | Scouting | 83 | 5 | 1500 |

| Table J.2. Summary of Postapplication Risk Assessment for Malathion-Malaoxon Using MRID 454919-02 Summer Squash DFR Data + Oxon Estimates | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| **Crop Group** | **Use Site** | **DFR Source[a]** | **App Rate[b] lbai/A** | **Transfer Coeficient[c] ($cm^2$/hr)** | **Activity[c]** | **MOE[d] at Day 0** | **DAT when MOE>1000** | **MOE[d]** |
| FIELD & ROW CROPS: LOW to MEDIUM (Nongrass Animal Feeds) | Alfalfa, Clover, Lespedeza, Lupine, Vetch | MRID 454919-02 | 0.61 ULV | 1900 | Irrigation (hand set) | 48 | 6 | 1600 |
| | | | | NA | Irrigation (non-hand set); Mechanical Harvesting; Fertilizing | NA | NA | NA |
| FIELD & ROW CROPS: LOW to MEDIUM (Cereal Grains) | Barley, Rice, Wild Rice | MRID 454919-02 | 1.25 | 1100 | Scouting | 41 | 6 | 1300 |
| | | | | NA | Mechanical Harvesting; Mechanical Swathing; Irrigation (non-hand set); Baling | NA | NA | NA |
| FIELD & ROW CROPS: LOW to MEDIUM (Cereal Grains) | Barley, Rice, Wild Rice | MRID 454919-02 | 0.61 ULV | 1100 | Scouting | 83 | 5 | 1500 |
| | | | | NA | Mechanical Harvesting; Mechanical Swathing; Irrigation (non-hand set); Baling | NA | NA | NA |
| FIELD & ROW CROPS: LOW to MEDIUM (Cereal Grains) | Oats, Rye, Spring Wheat, Winter Wheat | MRID 454919-02 | 1 | 70 | Hand Weeding | 800 | 1 | 1400 |
| | | | | 1100 | Scouting | 51 | 6 | 1700 |
| | | | | NA | Mechanical Harvesting; Mechanical Swathing; Irrigation (non-hand set); Baling | NA | NA | NA |
| FIELD & ROW CROPS: LOW to MEDIUM (Cereal Grains) | Oats, Rye, Spring Wheat, Winter Wheat | MRID 454919-02 | 0.61 ULV | 70 | Hand Weeding | 1300 | 0 | 1300 |
| | | | | 1100 | Scouting | 83 | 5 | 1500 |
| | | | | NA | Mechanical Harvesting; Mechanical Swathing; Irrigation (non-hand set); Baling | NA | NA | NA |
| FIELD & ROW CROPS: LOW to MEDIUM (Fiber) | Cotton (non-boll weevil) | MRID 454919-02 | 2.5 | 70 | Hand Weeding | 320 | 2 | 1000 |
| | | | | 210 | Scouting | 110 | 4 | 1100 |
| | | | | Use Alternate TC Method | Mechanical Harvesting (module builder operator; picker operator; raker; tramper) | NA | NA | NA |
| | | | | NA | Irrigation (non-hand set); Mechanical Weeding | NA | NA | NA |

| Table J.2. Summary of Postapplication Risk Assessment for Malathion-Malaoxon Using MRID 454919-02 Summer Squash DFR Data + Oxon Estimates | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| **Crop Group** | **Use Site** | **DFR Source[a]** | **App Rate[b] lbai/A** | **Transfer Coeficient[c] ($cm^2$/hr)** | **Activity[c]** | **MOE[d] at Day 0** | **DAT when MOE>1000** | **MOE[d]** |
| FIELD & ROW CROPS: LOW to MEDIUM (Fiber) | Cotton (non-boll weevil) | MRID 454919-02 | 1.22 ULV | 70 | Hand Weeding | 650 | 1 | 1200 |
| | | | | 210 | Scouting | 220 | 3 | 1300 |
| | | | | Use Alternate TC Method | Mechanical Harvesting (module builder operator; picker operator; raker; tramper) | NA | NA | NA |
| | | | | NA | Irrigation (non-hand set); Mechanical Weeding | NA | NA | NA |
| FIELD & ROW CROPS: LOW to MEDIUM (Fiber) | Flax | MRID 454919-02 | 0.5 | 1100 | Scouting | 100 | 4 | 1000 |
| | | | | NA | Mechanical Harvesting | NA | NA | NA |
| FIELD & ROW CROPS: LOW to MEDIUM (Forage Grass) | Grass: Forage and Hay | MRID 454919-02 | 1.25 | 1100 | Scouting | 41 | 6 | 1300 |
| | | | | 1900 | Irrigation (hand set) | 24 | 7 | 1400 |
| | | | | NA | Irrigation (non-hand set); Mechanical Harvesting ; Fertilizing | NA | NA | NA |
| FIELD & ROW CROPS: LOW to MEDIUM (Herbs & Spices) | Mint | MRID 454919-02 | 0.94 | 70 | Hand Weeding | 850 | 1 | 1500 |
| | | | | 1100 | Scouting | 54 | 5 | 1000 |
| | | | | 1900 | Irrigation (hand set) | 31 | 6 | 1000 |
| | | | | NA | Irrigation (non-hand set); Mechanical Harvesting ; Transplanting | NA | NA | NA |
| FIELD & ROW CROPS: LOW to MEDIUM (Legume Vegetable) | Peas (succulent) | MRID 454919-02 | 1 | 70 | Hand Weeding | 800 | 1 | 1400 |
| | | | | 210 | Scouting | 270 | 3 | 1500 |
| | | | | 1100 | Hand Harvesting | 51 | 6 | 1700 |
| | | | | 1900 | Irrigation (hand set) | 29 | 7 | 1800 |
| | | | | NA | Irrigation (non-hand set); Mechanical Harvesting; Fertilizing; Mechanical Weeding | NA | NA | NA |
| | | | | 70 | Hand Weeding | 1300 | 0 | 1300 |

| Table J.2. Summary of Postapplication Risk Assessment for Malathion-Malaoxon Using MRID 454919-02 Summer Squash DFR Data + Oxon Estimates | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| **Crop Group** | **Use Site** | **DFR Source[a]** | **App Rate[b] lbai/A** | **Transfer Coeficient[c] ($cm^2$/hr)** | **Activity[c]** | **MOE[d] at Day 0** | **DAT when MOE>1000** | **MOE[d]** |
| FIELD & ROW CROPS: LOW to MEDIUM (Legume Vegetable) | Beans (lima, snap, and succulent) | MRID 454919-02 | 0.61 ULV | 210 | Scouting | 440 | 2 | 1400 |
| | | | | 1100 | Hand Harvesting | 83 | 5 | 1500 |
| | | | | 1900 | Irrigation (hand set) | 48 | 6 | 1600 |
| | | | | NA | Irrigation (non-hand set); Mechanical Harvesting; Mechanical Weeding; Fertilizing | NA | NA | NA |
| FIELD & ROW CROPS: LOW to MEDIUM (Pea and Bean - dry shelled, except soybean) | Beans (dry) | MRID 454919-02 | 0.61 ULV | 1100 | Scouting | 83 | 5 | 1500 |
| | | | | 1900 | Irrigation (hand set) | 48 | 6 | 1600 |
| | | | | NA | Irrigation (non-hand set); Mechanical Harvesting; Mechanical Swathing; Mechanical Weeding; Fertilizing; Mechanical Knifing | NA | NA | NA |
| FIELD & ROW CROPS: TALL | Corn (field, pop, and sweet grown for processing) | MRID 454919-02 | 1 | 70 | Hand Weeding | 800 | 1 | 1400 |
| | | | | 210 | Scouting to low height corn | 270 | 3 | 1500 |
| | | | | 1100 | Scouting to tall, full foliage | 51 | 6 | 1700 |
| | | | | 1900 | Irrigation (hand set) | 29 | 7 | 800 |
| | | | | NA | Irrigation (non-hand set); Mechanical Harvesting and Weeding; Topping | NA | NA | NA |
| FIELD & ROW CROPS: TALL | Corn (field, pop, and sweet grown for processing) | MRID 454919-02 | 0.61 ULV | 70 | Hand Weeding | 1300 | 0 | 1300 |
| | | | | 210 | Scouting to low height corn | 440 | 2 | 1400 |
| | | | | 1100 | Scouting to tall, full foliage corn | 83 | 5 | 1500 |
| | | | | 1900 | Irrigation (hand set) | 48 | 6 | 1600 |
| | | | | NA | Irrigation (non-hand set); Mechanical Harvesting and Weeding; Topping | NA | NA | NA |
| | Corn (grain, sweet grown | MRID 454919-02 | 1 | 70 | Hand Weeding | 800 | 1 | 1400 |
| | | | | 210 | Scouting to low height corn | 270 | 3 | 1500 |

| Table J.2. Summary of Postapplication Risk Assessment for Malathion-Malaoxon Using MRID 454919-02 Summer Squash DFR Data + Oxon Estimates | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| **Crop Group** | **Use Site** | **DFR Source[a]** | **App Rate[b] lbai/A** | **Transfer Coeficient[c] ($cm^2$/hr)** | **Activity[c]** | **MOE[d] at Day 0** | **DAT when MOE>1000** | **MOE[d]** |
| FIELD & ROW CROPS: TALL | for fresh market, and corn grown for seed production) | | | 1100 | Scouting to tall, full foliage corn | 51 | 6 | 1700 |
| | | | | 1900 | Irrigation (hand set) | 29 | 7 | 800 |
| | | | | 8800 | Hand Detasselling; Hand Harvesting | 6.4 | 9 | 1200 |
| | | | | NA | Irrigation (non-hand set); Mechanical Harvesting and Weeding; Topping | NA | NA | NA |
| FIELD & ROW CROPS: TALL | Corn (grain, sweet grown for fresh market, and corn grown for seed production) | MRID 454919-02 | 0.61 ULV | 70 | Hand Weeding | 1300 | 0 | 1300 |
| | | | | 210 | Scouting to low height corn | 440 | 2 | 1400 |
| | | | | 1100 | Scouting to tall, full foliage corn | 83 | 5 | 1500 |
| | | | | 1900 | Irrigation (hand set) | 48 | 6 | 1600 |
| | | | | 8800 | Hand Detasselling; Hand Harvesting | 10 | 8 | 1100 |
| | | | | NA | Irrigation (non-hand set); Mechanical Harvesting and Weeding; Topping | NA | NA | NA |
| FIELD & ROW CROPS: TALL | Sorghum | MRID 454919-02 | 1 | 70 | Hand Weeding | 800 | 1 | 1400 |
| | | | | 210 | Scouting | 270 | 3 | 1500 |
| | | | | NA | Irrigation (non-hand set); Mechanical Harvesting; Mechanical Weeding | NA | NA | NA |
| FIELD & ROW CROPS: TALL | Sorghum | MRID 454919-02 | 0.61 ULV | 70 | Hand Weeding | 1300 | 0 | 1300 |
| | | | | 210 | Scouting | 440 | 2 | 1400 |
| | | | | NA | Irrigation (non-hand set); Mechanical Harvesting; Mechanical Weeding | NA | NA | NA |
| VEGETABLE: ROOT & TUBER | Garlic, Onion (bulb) | MRID 454919-02 | 1.56 | 330 | Scouting; Thinning | 110 | 4 | 1100 |
| | | | | 1400 | Scouting; Hand Weeding | 26 | 7 | 1500 |
| | | | | 1900 | Irrigation (hand set) | 19 | 7 | 1100 |

| Table J.2. Summary of Postapplication Risk Assessment for Malathion-Malaoxon Using MRID 454919-02 Summer Squash DFR Data + Oxon Estimates | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| **Crop Group** | **Use Site** | **DFR Source[a]** | **App Rate[b] lbai/A** | **Transfer Coeficient[c] ($cm^2$/hr)** | **Activity[c]** | **MOE[d] at Day 0** | **DAT when MOE>1000** | **MOE[d]** |
| | | | | 4200 | Hand Weeding | 8.5 | 9 | 1600 |
| | | | | Use Alternate TC Method | Hand Harvesting | NA | NA | NA |
| | | | | NA | Irrigation (non-hand set); Mechanical Harvesting; Mechanical Weeding | NA | NA | NA |
| VEGETABLE: ROOT & TUBER | Leek, Onion (green), Shallot | MRID 454919-02 | 1.56 | 330 | Scouting; Thinning | 110 | 4 | 1100 |
| | | | | 1400 | Scouting; Hand Weeding; Hand Harvesting | 26 | 7 | 1500 |
| | | | | 1900 | Irrigation (hand set) | 19 | 7 | 1100 |
| | | | | 4200 | Hand Weeding | 8.5 | 9 | 1600 |
| | | | | NA | Mechanical Harvesting; Mechanical Weeding | NA | NA | NA |
| VEGETABLE: ROOT & TUBER | Potato | MRID 454919-02 | 1.56 | 70 | Hand Weeding | 510 | 2 | 1600 |
| | | | | 210 | Scouting | 170 | 4 | 1800 |
| | | | | 1900 | Irrigation (hand set) | 19 | 7 | 1100 |
| | | | | Use Alternate TC Method | Hand Harvesting | NA | NA | NA |
| | | | | NA | Irrigation (non-hand set); Mechanical Harvesting; Mechanical Weeding | NA | NA | NA |
| VEGETABLE: ROOT & TUBER | Sweet Potato, Yam | MRID 454919-02 | 1.56 | 70 | Hand Weeding | 510 | 2 | 1600 |
| | | | | 210 | Scouting | 170 | 4 | 1800 |

| Table J.2. Summary of Postapplication Risk Assessment for Malathion-Malaoxon Using MRID 454919-02 Summer Squash DFR Data + Oxon Estimates | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| **Crop Group** | **Use Site** | **DFR Source[a]** | **App Rate[b] lbai/A** | **Transfer Coeficient[c] ($cm^2$/hr)** | **Activity[c]** | **MOE[d] at Day 0** | **DAT when MOE>1000** | **MOE[d]** |
| | | | | 230 | Transplanting | 160 | 4 | 1600 |
| | | | | 1900 | Irrigation (hand set) | 19 | 7 | 1100 |
| | | | | Use Alternate TC Method | Hand Harvesting | NA | NA | NA |
| | | | | NA | Irrigation (non-hand set); Mechanical Harvesting; Mechanical Weeding | NA | NA | NA |
| VEGETABLE: ROOT & TUBER | Horseradish | MRID 454919-02 | 1.25 | 70 | Hand Weeding | 640 | 1 | 1100 |
| | | | | 210 | Scouting | 210 | 3 | 1200 |
| | | | | 230 | Transplanting | 190 | 3 | 1100 |
| | | | | 1900 | Irrigation (hand set) | 24 | 7 | 1400 |
| | | | | Use Alternate TC Method | Hand Harvesting | NA | NA | NA |
| | | | | NA | Irrigation (non-hand set); Hand Harvesting; Hand Weeding | NA | NA | NA |
| VEGETABLE: ROOT & TUBER | Carrot, Chayote Root, Garden Beet, Parsnip, Salsify, Turnip (root) | MRID 454919-02 | 1.25 | 70 | Hand Weeding; Thinning Plants (Beet, Turnip) | 640 | 1 | 1100 |
| | | | | 210 | Scouting | 210 | 3 | 1200 |
| | | | | 1100 | Hand Harvesting | 41 | 6 | 1300 |
| | | | | 1900 | Irrigation (hand set) | 24 | 7 | 1400 |
| | | | | NA | Irrigation (non-hand set); Mechanical Harvesting; Mechanical Weeding | NA | NA | NA |
| | Radish, Rutabaga | MRID 454919-02 | 1 | 70 | Hand Weeding; Thinning Plants | 800 | 1 | 1400 |
| | | | | 210 | Scouting | 270 | 3 | 1500 |

| Table J.2. Summary of Postapplication Risk Assessment for Malathion-Malaoxon Using MRID 454919-02 Summer Squash DFR Data + Oxon Estimates | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| **Crop Group** | **Use Site** | **DFR Source[a]** | **App Rate[b] lbai/A** | **Transfer Coeficient[c] ($cm^2$/hr)** | **Activity[c]** | **MOE[d] at Day 0** | **DAT when MOE>1000** | **MOE[d]** |
| VEGETABLE: ROOT & TUBER | | | | 1100 | Hand Harvesting | 51 | 6 | 1700 |
| | | | | 1900 | Irrigation (hand set) | 29 | 7 | 1800 |
| | | | | NA | Irrigation (non-hand set); Mechanical Weeding; Mechanical Harvesting | NA | NA | NA |
| VEGETABLE: CUCURBIT | Chayote Fruit, Cucumber, Summer Squash | MRID 454919-02 | 1.75 | 90 | Scouting; Hand Weeding; Hand Pruning; Thinning | 350 | 2 | 1100 |
| | | | | 230 | Transplanting | 140 | 4 | 1400 |
| | | | | 550 | Training; Hand Harvesting; Mechanically-assisted Harvesting | 58 | 5 | 1100 |
| | | | | 1900 | Irrigation (hand set) | 17 | 7 | 1000 |
| | | | | NA | Irrigation (non-hand set); Mechanical Weeding | NA | NA | NA |
| VEGETABLE: CUCURBIT | Watermelon | MRID 454919-02 | 1.5 | 90 | Scouting; Hand Weeding: Hand Pruning; Thinning Fruit | 410 | 2 | 1300 |
| | | | | 230 | Transplanting | 160 | 4 | 1700 |
| | | | | 550 | Training; Turning; Hand Harvesting; Mechanically-assisted Harvesting | 68 | 5 | 1300 |
| | | | | 1900 | Irrigation (hand set) | 20 | 7 | 1200 |
| | | | | NA | Irrigation (non-hand set); Mechanical Weeding | NA | NA | NA |
| VEGETABLE: CUCURBIT | Cantaloupe, Melon, Pumpkin, Winter Squash | MRID 454919-02 | 1 | 90 | Scouting; Hand Weeding: Hand Pruning; Thinning Fruit | 620 | 1 | 1100 |
| | | | | 230 | Transplanting | 240 | 3 | 1400 |
| | | | | 550 | Training; Turning; Hand and Mechanically-assisted Harvesting | 100 | 4 | 1000 |

| Table J.2. Summary of Postapplication Risk Assessment for Malathion-Malaoxon Using MRID 454919-02 Summer Squash DFR Data + Oxon Estimates | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| **Crop Group** | **Use Site** | **DFR Source[a]** | **App Rate[b] lbai/A** | **Transfer Coeficient[c] ($cm^2$/hr)** | **Activity[c]** | **MOE[d] at Day 0** | **DAT when MOE>1000** | **MOE[d]** |
| | | | | 1900 | Irrigation (hand set) | 29 | 7 | 1800 |
| | | | | NA | Irrigation (non-hand set); Mechanical Weeding | NA | NA | NA |
| VEGETABLE: FRUITING | Eggplant, Oriental Eggplant | MRID 454919-02 | 1.56 | 90 | Scouting; Hand Weeding: Hand Pruning; Thinning Fruit | 400 | 2 | 1300 |
| | | | | 230 | Transplanting | 160 | 4 | 1600 |
| | | | | 550 | Tying/Training; Hand Harvesting | 65 | 5 | 1200 |
| | | | | 1900 | Irrigation (hand set) | 19 | 7 | 1100 |
| | | | | NA | Irrigation (non-hand set) | NA | NA | NA |
| VEGETABLE: FRUITING | Pepper, Tomatillo, Tomato | MRID 454919-02 | 1.56 | 70 | Hand Weeding; Hand Pruning | 510 | 2 | 1600 |
| | | | | 210 | Scouting | 170 | 4 | 1800 |
| | | | | 230 | Transplanting | 160 | 4 | 1600 |
| | | | | 1100 | Tying/Training; Hand Harvesting | 33 | 6 | 1100 |
| | | | | 1900 | Irrigation (hand set) | 19 | 7 | 1100 |
| | | | | NA | Irrigation (non-hand set) | NA | NA | NA |
| VEGETABLE: FRUITING | Okra | MRID 454919-02 | 1.2 | 70 | Hand Weeding | 670 | 1 | 1200 |
| | | | | 210 | Scouting | 220 | 3 | 1300 |
| | | | | 230 | Transplanting | 200 | 3 | 1200 |
| | | | | 1100 | Tying/Training; Hand Harvesting | 42 | 6 | 1400 |
| | | | | 1900 | Irrigation (hand set) | 25 | 7 | 1500 |
| | | | | NA | Irrigation (non-hand set); Mechanical Weeding | NA | NA | NA |
| | | | 1.25 | 230 | Transplanting | 190 | 3 | 1100 |

| Table J.2. Summary of Postapplication Risk Assessment for Malathion-Malaoxon Using MRID 454919-02 Summer Squash DFR Data + Oxon Estimates | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| **Crop Group** | **Use Site** | **DFR Source[a]** | **App Rate[b] lbai/A** | **Transfer Coeficient[c] ($cm^2$/hr)** | **Activity[c]** | **MOE[d] at Day 0** | **DAT when MOE>1000** | **MOE[d]** |
| VEGETABLE: HEAD & STEM BRASSICA | Broccoli, Broccoli Raab | MRID 454919-02 | | 330 | Scouting (minimal foliage); Thinning Plants | 140 | 4 | 1400 |
| | | | | 1400 | Hand Weeding (minimal foliage) | 32 | 6 | 1100 |
| | | | | 1900 | Irrigation (hand set) | 24 | 7 | 1400 |
| | | | | 4200 | Hand Weeding (full foliage); Scouting (full foliage); Hand Harvesting | 11 | 8 | 1100 |
| | | | | NA | Mechanical Weeding; Irrigation (non-hand set); Injection Fertilizing | NA | NA | NA |
| VEGETABLE: HEAD & STEM BRASSICA | Cabbage, Kohlrabi | MRID 454919-02 | 1.25 | 230 | Transplanting | 190 | 3 | 1100 |
| | | | | 330 | Scouting (minimal foliage); Thinning Plants | 140 | 4 | 1400 |
| | | | | 1400 | Hand Weeding (minimal foliage); Hand and Mechanically-assisted Harvesting; Scouting (full foliage) | 32 | 6 | 1100 |
| | | | | 1900 | Irrigation (hand set) | 24 | 7 | 1400 |
| | | | | 4200 | Hand Weeding (full foliage) | 11 | 8 | 1100 |
| | | | | NA | Irrigation (non-hand set); Mechanical Weeding | NA | NA | NA |
| VEGETABLE: HEAD & STEM BRASSICA | Cauliflower | MRID 454919-02 | 1.25 | 230 | Transplanting | 190 | 3 | 1100 |
| | | | | 330 | Scouting (minimal foliage); Thinning Plants | 140 | 4 | 1400 |
| | | | | 1400 | Hand Weeding (minimal foliage) | 32 | 6 | 1100 |

| Table J.2. Summary of Postapplication Risk Assessment for Malathion-Malaoxon Using MRID 454919-02 Summer Squash DFR Data + Oxon Estimates | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| **Crop Group** | **Use Site** | **DFR Source[a]** | **App Rate[b] lbai/A** | **Transfer Coeficient[c] ($cm^2$/hr)** | **Activity[c]** | **MOE[d] at Day 0** | **DAT when MOE>1000** | **MOE[d]** |
| | | | | 1900 | Irrigation (hand set) | 24 | 7 | 1400 |
| | | | | 4200 | Hand Weeding (full foliage); Scouting (full foliage); Hand Harvesting; Tying/Training | 11 | 8 | 1100 |
| | | | | NA | Irrigation (non-hand set); Injection Fertilizing; Mechanical Weeding | NA | NA | NA |
| VEGETABLE: HEAD & STEM BRASSICA | Brussels Sprouts, Chinese Broccoli | MRID 454919-02 | 1.25 | 230 | Transplanting | 190 | 3 | 1100 |
| | | | | 330 | Scouting (minimal foliage) | 140 | 4 | 1400 |
| | | | | 1900 | Irrigation (hand set) | 24 | 7 | 1400 |
| | | | | 4200 | Hand Weeding (full foliage); Scouting (full foliage); Hand Harvesting; Topping | 11 | 8 | 1100 |
| | | | | NA | Irrigation (non-hand set); Mechanical Weeding | NA | NA | NA |
| VEGETABLE: LEAFY | Spinach | MRID 454919-02 | 2 | 70 | Hand Weeding; Thinning Plants | 400 | 2 | 1300 |
| | | | | 210 | Scouting | 130 | 4 | 1400 |
| | | | | 230 | Transplanting | 120 | 4 | 1300 |
| | | | | 1100 | Hand Harvesting | 25 | 7 | 1500 |
| | | | | 1900 | Irrigation (hand set) | 15 | 8 | 1600 |
| | | | | NA | Irrigation (non-hand set); Mechanical Weeding | NA | NA | NA |
| VEGETABLE: LEAFY | Lettuce, head and leaf | MRID 454919-02 | 1.88 | 70 | Hand Weeding: Thinning Plants | 420 | 2 | 1400 |
| | | | | 210 | Scouting | 140 | 4 | 1500 |
| | | | | 230 | Transplanting | 130 | 4 | 1300 |
| | | | | 1100 | Hand Harvesting | 27 | 7 | 1600 |
| | | | | 1900 | Irrigation (hand set) | 16 | 8 | 1700 |
| | | | | NA | Irrigation (non-hand set); Mechanical Weeding | NA | NA | NA |

| Table J.2. Summary of Postapplication Risk Assessment for Malathion-Malaoxon Using MRID 454919-02 Summer Squash DFR Data + Oxon Estimates | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| **Crop Group** | **Use Site** | **DFR Source[a]** | **App Rate[b] lbai/A** | **Transfer Coeficient[c] ($cm^2$/hr)** | **Activity[c]** | **MOE[d] at Day 0** | **DAT when MOE>1000** | **MOE[d]** |
| VEGETABLE: LEAFY | Celery, Parsley | MRID 454919-02 | 1.5 | 70 | Hand Weeding; Thinning Plants (parsley) | 530 | 2 | 1700 |
| | | | | 210 | Scouting | 180 | 3 | 1000 |
| | | | | 230 | Transplanting | 160 | 4 | 1700 |
| | | | | 1100 | Hand Harvesting | 34 | 6 | 1100 |
| | | | | 1900 | Irrigation (hand set) | 20 | 7 | 1200 |
| | | | | NA | Irrigation (non-hand set); Mechanical Weeding | NA | NA | NA |
| VEGETABLE: LEAFY | Dandelion, Endive, Turnip Green, Watercress | MRID 454919-02 | 1.25 | 70 | Hand Weeding: Thinning Plants | 640 | 1 | 1100 |
| | | | | 210 | Scouting | 210 | 3 | 1200 |
| | | | | 230 | Transplanting | 190 | 3 | 1100 |
| | | | | 1100 | Hand Harvesting | 41 | 6 | 1300 |
| | | | | 1900 | Irrigation (hand set) | 24 | 7 | 1400 |
| | | | | NA | Irrigation (non-hand set); Mechanical Weeding | NA | NA | NA |
| VEGETABLE: LEAFY | Chinese Greens | MRID 454919-02 | 1.25 | 230 | Transplanting | 190 | 3 | 1100 |
| | | | | 330 | Scouting (minimal foliage); Thinning Plants | 140 | 4 | 1400 |
| | | | | 1400 | Hand Weeding (minimal foliage): Hand Harvesting; Scouting (full foliage) | 32 | 6 | 1100 |
| | | | | 1900 | Irrigation (hand set) | 24 | 7 | 1400 |
| | | | | 4200 | Hand Weeding (full foliage) | 11 | 8 | 1100 |

| Table J.2. Summary of Postapplication Risk Assessment for Malathion-Malaoxon Using MRID 454919-02 Summer Squash DFR Data + Oxon Estimates | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| **Crop Group** | **Use Site** | **DFR Source[a]** | **App Rate[b] lbai/A** | **Transfer Coeficient[c] ($cm^2$/hr)** | **Activity[c]** | **MOE[d] at Day 0** | **DAT when MOE>1000** | **MOE[d]** |
| | | | | NA | Irrigation (non-hand set); Mechanical Weeding | NA | NA | NA |
| VEGETABLE: LEAFY | Collard, Kale, Mustard Green, Swiss Chard | MRID 454919-02 | 1 | 70 | Hand Weeding: Thinning Plants | 800 | 1 | 1400 |
| | | | | 210 | Scouting | 270 | 3 | 1500 |
| | | | | 230 | Transplanting | 240 | 3 | 1400 |
| | | | | 1100 | Hand Harvesting | 51 | 6 | 1700 |
| | | | | 1900 | Irrigation (hand set) | 29 | 7 | 1800 |
| | | | | NA | Irrigation (non-hand set); Mechanical Weeding | NA | NA | NA |
| VEGETABLE: STALK & STEM | Asparagus | MRID 454919-02 | 1.25 | 70 | Hand Weeding | 640 | 1 | 1100 |
| | | | | 210 | Scouting | 210 | 3 | 1200 |
| | | | | 230 | Transplanting | 190 | 3 | 1100 |
| | | | | 1100 | Hand Harvesting | 41 | 6 | 1300 |
| | | | | 1900 | Irrigation (hand set) | 24 | 7 | 1400 |
| | | | | NA | Irrigation (non-hand set); Mechanical Weeding; Fertilizing | NA | NA | NA |

**NA**: Not Available – no known transfer coefficient for this activity, therefore, MOEs could not be calculated.

a. DFR Source: ARETF Malathion DFR studies were used to calculate DFR residues for malathion. Malaoxon residues were not measured in the studies, but were estimated to be 5% of the parent. Regressions were run to provide predicted malathion-malaoxon residues after treatment. Additionally, a 22x toxicity adjustment factor was applied to the estimated malaoxon residue to account for the additional toxicity of the oxon. Regression was run based on: Estimated DFR of Malathion-Malaoxon = malathion DFR + 22 X (0.05 malathion DFR)
   - MRID 454919-02 Squash Study application rate 0.95 lb ai/acre

b. Application rates are the maximum application rates determined from EPA registered labels for malathion.

c. Transfer Coefficient and Post Application Activities from EPA's Occupational Pesticide Re-entry Exposure Calculator – Revised March 2013.

d. MOE calculated using dermal dose and POD for malathion (80 mg/kg/day). Dermal Dose (mg/kg/day) = DFR (µg/$cm^2$) x 8 hr x transfer coefficient ($cm^2$/hr) / 1000 x body weight (69 kg). MOE = POD (mg/kg/day) / dermal dose (mg/kg/day. Level of Concern (LOC) = 1,000.

| Table J.3. Summary of Postapplication Risk Assessment for Malathion-Malaoxon Using MRID 451382-02 Apples DFR Data + Oxon Estimates | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| **Crop Group** | **Use Site** | **DFR Source[a]** | **App Rate[b] lbai/A** | **Transfer Coeficient[c] ($cm^2$/hr)** | **Activity[c]** | **MOE[d] at Day 0** | **DAT when MOE>1000** | **MOE[d]** |
| TREE FRUIT: DECIDUOUS (Pome Fruits) | Pear | MRID 451382-02 | 1.25 | 100 | Orchard Maintenance; Hand Weeding: Propping | 2100 | 0 | 2100 |
| | | | | 230 | Transplanting | 930 | 1 | 1500 |
| | | | | 580 | Scouting; Hand Pruning (full foliage); Training | 370 | 2 | 1000 |
| | | | | 1400 | Hand Harvesting | 150 | 4 | 1200 |
| | | | | 3600 | Thinning Fruit | 59 | 6 | 1300 |
| | | | | Use Alternate TC Method | Hand Pruning (minimal foliage) | NA | NA | NA |
| | | | | NA | Irrigation (non-hand set); Mechanical Weeding; Fertilizing | NA | NA | NA |
| TREE FRUIT: DECIDUOUS (No Group Name) | Fig | MRID 451382-02 | 2 | 100 | Orchard Maintenance; Hand Weeding | 1300 | 0 | 1300 |
| | | | | 230 | Transplanting | 270 | 3 | 1300 |
| | | | | 580 | Scouting; Hand Pruning (full foliage); | 230 | 3 | 1100 |
| | | | | 1400 | Hand Harvesting; Pollination | 95 | 5 | 1200 |
| | | | | Use Alternate TC Method | Hand Pruning (minimal foliage) | NA | NA | NA |
| | | | | NA | Irrigation (non-hand set); Mechanical Harvesting; Mechanical Weeding | NA | NA | NA |
| TREE FRUIT: DECIDUOUS (Stone Fruit) | Nectarine, Peach | MRID 451382-02 | 3 | 100 | Orchard Maintenance; Hand Weeding; Propping; | 890 | 1 | 1500 |
| | | | | 230 | Transplanting | 390 | 2 | 1100 |
| | | | | 580 | Scouting; Hand Pruning (full foliage); Training | 150 | 4 | 1200 |

| Table J.3. Summary of Postapplication Risk Assessment for Malathion-Malaoxon Using MRID 451382-02 Apples DFR Data + Oxon Estimates | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| **Crop Group** | **Use Site** | **DFR Source[a]** | **App Rate[b] lbai/A** | **Transfer Coeficient[c] ($cm^2$/hr)** | **Activity[c]** | **MOE[d] at Day 0** | **DAT when MOE>1000** | **MOE[d]** |
| | | | | 1400 | Hand Harvesting | 63 | 6 | 1400 |
| | | | | 3600 | Thinning Fruit | 25 | 8 | 1500 |
| | | | | Use Alternate TC Method | Hand Pruning (minimal foliage) | NA | NA | NA |
| | | | | NA | Irrigation (non-hand set); Mechanical Harvesting; Mechanical Weeding; Fertilizing; Spreading Bins | NA | NA | NA |
| TREE FRUIT: DECIDUOUS (Stone Fruit) | Cherry (sweet and tart) | MRID 451382-02 | 1.75 | 100 | Orchard Maintenance; Hand Weeding; Propping; Bird Control | 1500 | 0 | 1500 |
| | | | | 230 | Transplanting | 660 | 1 | 1100 |
| | | | | 580 | Scouting; Hand Pruning (full foliage); Training | 260 | 3 | 1200 |
| | | | | 1400 | Hand Harvesting | 110 | 5 | 1400 |
| | | | | 3600 | Thinning Fruit | 42 | 7 | 1500 |
| | | | | Use Alternate TC Method | Hand Pruning (minimal foliage) | NA | NA | NA |
| | | | | NA | Irrigation (non-hand set); Mechanical Harvesting; Mechanical Weeding; Fertilizing; Spreading Bins | NA | NA | NA |
| TREE FRUIT: DECIDUOUS (Stone Fruit) | Cherry (sweet and tart) | MRID 451382-02 | 1.22 ULV | 100 | Orchard Maintenance; Hand Weeding: Propping; Bird Control | 2200 | 0 | 2200 |
| | | | | 230 | Transplanting | 950 | 1 | 1600 |
| | | | | 580 | Scouting; Hand Pruning (full foliage); Training | 380 | 2 | 1000 |
| | | | | 1400 | Hand Harvesting | 160 | 4 | 1200 |
| | | | | 3600 | Thinning Fruit | 61 | 6 | 1300 |

| Table J.3. Summary of Postapplication Risk Assessment for Malathion-Malaoxon Using MRID 451382-02 Apples DFR Data + Oxon Estimates | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| **Crop Group** | **Use Site** | **DFR Source[a]** | **App Rate[b] lbai/A** | **Transfer Coeficient[c] ($cm^2$/hr)** | **Activity[c]** | **MOE[d] at Day 0** | **DAT when MOE>1000** | **MOE[d]** |
| | | | | Use Alternate TC Method | Hand Pruning (minimal foliage) | NA | NA | NA |
| | | | | NA | Irrigation (non-hand set); Mechanical Harvesting; Mechanical Weeding; Fertilizing; Spreading Bins | NA | NA | NA |
| TREE FRUIT: DECIDUOUS (Stone Fruit) | Apricot | MRID 451382-02 | 1.5 | 100 | Orchard Maintenance; Hand Weeding; Propping; Bird Control | 1800 | 0 | 1800 |
| | | | | 230 | Transplanting | 770 | 1 | 1300 |
| | | | | 580 | Scouting; Hand Pruning (full foliage); Training | 310 | 3 | 1400 |
| | | | | 1400 | Hand Harvesting | 130 | 5 | 1600 |
| | | | | 3600 | Thinning Fruit | 49 | 6 | 1100 |
| | | | | Use Alternate TC | Hand Pruning (minimal foliage) | NA | NA | NA |
| | | | | NA | Mechanical Harvesting; Mechanical Weeding; Irrigation (non-hand set); Spreading Bins | NA | NA | NA |
| TREE FRUIT: EVERGREEN (Citrus Fruit) | CA ONLY: Grapefruit, Lemon, Lime, Orange, Tangelo, Tangerine | MRID 451382-02 | 7.5 | 100 | Orchard Maintenance; Hand Weeding: Baiting; Trapping | 350 | 3 | 1700 |
| | | | | 230 | Transplanting | 150 | 4 | 1200 |
| | | | | 580 | Scouting; Hand Pruning (full foliage) | 61 | 6 | 1300 |
| | | | | 1400 | Hand Harvesting | 25 | 8 | 1500 |
| | | | | Use Alternate TC Method | Hand Pruning (minimal foliage) | NA | NA | NA |

| Table J.3. Summary of Postapplication Risk Assessment for Malathion-Malaoxon Using MRID 451382-02 Apples DFR Data + Oxon Estimates | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| **Crop Group** | **Use Site** | **DFR Source[a]** | **App Rate[b] lbai/A** | **Transfer Coeficient[c] ($cm^2$/hr)** | **Activity[c]** | **MOE[d] at Day 0** | **DAT when MOE>1000** | **MOE[d]** |
| | | | | NA | Irrigation (non-hand set); Mechanical Weeding; Mechanical Pruning | NA | NA | NA |
| TREE FRUIT: EVERGREEN (Citrus Fruit) | Grapefruit, Kumquat, Lemon, Lime, Orange, Tangelo, Tangerine | MRID 451382-02 | 4.5 | 100 | Orchard Maintenance; Hand Weeding: Baiting; Trapping | 590 | 2 | 1600 |
| | | | | 230 | Transplanting | 260 | 3 | 1200 |
| | | | | 580 | Scouting; Hand Pruning (full foliage) | 100 | 5 | 1300 |
| | | | | 1400 | Hand Harvesting | 42 | 7 | 1500 |
| | | | | Use Alternate TC Method | Hand Pruning (minimal foliage) | NA | NA | NA |
| | | | | NA | Irrigation (non-hand set); Mechanical Weeding; Mechanical Pruning | NA | NA | NA |
| TREE FRUIT: EVERGREEN (Citrus Fruit) | Grapefruit, Lemon, Lime, Orange, Tangelo, Tangerine | MRID 451382-02 | 1.5 | 100 | Orchard Maintenance; Hand Weeding: Baiting; Trapping | 1800 | 0 | 1800 |
| | | | | 230 | Transplanting | 770 | 1 | 1300 |
| | | | | 580 | Scouting; Hand Pruning (full foliage) | 310 | 3 | 1400 |
| | | | | 1400 | Hand Harvesting | 130 | 5 | 1600 |
| | | | | Use Alternate TC Method | Hand Pruning (minimal foliage) | NA | NA | NA |
| | | | | NA | Irrigation (non-hand set); Mechanical Weeding; Mechanical Pruning | NA | NA | NA |
| TREE FRUIT: EVERGREEN (Citrus Fruit) | Grapefruit, Kumquat, Lemon, Lime, | MRID 451382-02 | 0.18 ULV | 100 | Orchard Maintenance; Hand Weeding: Baiting; Trapping | 15000 | 0 | 15000 |
| | | | | 230 | Transplanting | 6400 | 0 | 6400 |

| Table J.3. Summary of Postapplication Risk Assessment for Malathion-Malaoxon Using MRID 451382-02 Apples DFR Data + Oxon Estimates | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| **Crop Group** | **Use Site** | **DFR Source[a]** | **App Rate[b] lbai/A** | **Transfer Coeficient[c] ($cm^2$/hr)** | **Activity[c]** | **MOE[d] at Day 0** | **DAT when MOE>1000** | **MOE[d]** |
| | Orange, Tangelo, Tangerine | | | 580 | Scouting; Hand Pruning (full foliage); | 2500 | 0 | 2500 |
| | | | | 1400 | Hand Harvesting | 1100 | 0 | 1100 |
| | | | | Use Alternate TC Method | Hand Pruning (minimal foliage) | NA | NA | NA |
| | | | | NA | Irrigation (non-hand set); Mechanical Weeding; Mechanical Pruning | NA | NA | NA |
| TREE FRUIT: EVERGREEN (Citrus Fruit) | Guava; FL ONLY for Lemon | MRID 451382-02 | 1.25 | 100 | Orchard Maintenance; Hand Weeding: Baiting; Trapping | 2100 | 0 | 2100 |
| | | | | 230 | Transplanting | 930 | 1 | 1500 |
| | | | | 580 | Scouting; Hand Pruning (full foliage) | 370 | 2 | 1000 |
| | | | | 1400 | Hand Harvesting | 150 | 4 | 1200 |
| | | | | Use Alternate TC Method | Hand Pruning (minimal foliage) | NA | NA | NA |
| | | | | NA | Irrigation (non-hand set); Mechanical Weeding; Mechanical Pruning | NA | NA | NA |
| TREE FRUIT: EVERGREEN (Tropical Fruit) | Avocado | MRID 451382-02 | 4.75 | 100 | Orchard Maintenance; Hand Weeding | 560 | 2 | 1600 |
| | | | | 230 | Transplanting | 240 | 3 | 1100 |
| | | | | 580 | Scouting; Hand Pruning (full foliage) | 97 | 5 | 1300 |
| | | | | 1400 | Hand Harvesting | 40 | 7 | 1400 |
| | | | | Use Alternate | Hand Pruning (minimal foliage) | NA | NA | NA |

| Table J.3. Summary of Postapplication Risk Assessment for Malathion-Malaoxon Using MRID 451382-02 Apples DFR Data + Oxon Estimates | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| **Crop Group** | **Use Site** | **DFR Source[a]** | **App Rate[b] lbai/A** | **Transfer Coeficient[c] ($cm^2$/hr)** | **Activity[c]** | **MOE[d] at Day 0** | **DAT when MOE>1000** | **MOE[d]** |
| | | | | TC Method | | | | |
| | | | | NA | Irrigation (non-hand set); Mechanical Weeding | NA | NA | NA |
| TREE FRUIT: EVERGREEN (Tropical Fruit) | Date | MRID 451382-02 | 4.25 | 100 | Hand Weeding | 630 | 1 | 1000 |
| | | | | 230 | Transplanting | 270 | 3 | 1300 |
| | | | | 580 | Scouting | 110 | 5 | 1400 |
| | | | | 1400 | Bagging Fruit; Hand Harvesting; Pollination; Dethorning Trees; Hand Pruning | 45 | 7 | 1600 |
| | | | | 3600 | Thinning Fruit | 17 | 8 | 1100 |
| | | | | NA | Mechanical Harvesting; Mechanical Weeding | NA | NA | NA |
| TREE FRUIT: EVERGREEN (Tropical Fruit) | Papaya | MRID 451382-02 | 1.25 | 100 | Orchard Maintenance; Hand Weeding | 2100 | 0 | 2100 |
| | | | | 230 | Transplanting | 930 | 1 | 1500 |
| | | | | 580 | Scouting; Hand Pruning | 370 | 2 | 1000 |
| | | | | 1400 | Hand Harvesting | 150 | 4 | 1200 |
| | | | | NA | Irrigation (non-hand set) | NA | NA | NA |
| TREE FRUIT: EVERGREEN (Tropical Fruit) | Mango | MRID 451382-02 | 0.94 | 580 | Scouting; Hand Pruning | 490 | 2 | 1400 |
| | | | | 1400 | Hand Harvesting | 200 | 4 | 1600 |
| | | | | 3600 | Thinning Fruit | 79 | 5 | 1000 |
| TREE FRUIT: EVERGREEN (Pine trees) | Christmas Tree Plantation | MRID 451382-02 | 3.2 | 100 | Hand Weeding: Grading/Tagging | 830 | 1 | 1400 |
| | | | | 230 | Transplanting | 360 | 2 | 1000 |
| | | | | 580 | Scouting; Shaping | 140 | 4 | 1100 |
| | | | | 1400 | Hand Harvesting | 59 | 6 | 1300 |
| | | | | 1900 | Irrigation (hand set) | 44 | 7 | 1600 |

| Table J.3. Summary of Postapplication Risk Assessment for Malathion-Malaoxon Using MRID 451382-02 Apples DFR Data + Oxon Estimates | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| **Crop Group** | **Use Site** | **DFR Source[a]** | **App Rate[b] lbai/A** | **Transfer Coeficient[c] ($cm^2$/hr)** | **Activity[c]** | **MOE[d] at Day 0** | **DAT when MOE>1000** | **MOE[d]** |
| | | | | NA | Irrigation (non-hand set); Mechanical Weeding; Mechanical Pruning; Fertilizing | NA | NA | NA |
| TREE FRUIT: EVERGREEN (Pine trees) | Christmas Tree Plantation | MRID 451382-02 | 0.94 ULV | 100 | Hand Weeding: Grading/Tagging | 2800 | 0 | 2800 |
| | | | | 230 | Transplanting | 1200 | 0 | 1200 |
| | | | | 580 | Scouting; Shaping | 490 | 2 | 1400 |
| | | | | 1400 | Hand Harvesting | 200 | 4 | 1600 |
| | | | | 1900 | Irrigation (hand set) | 150 | 4 | 1200 |
| | | | | NA | Irrigation (non-hand set); Mechanical Weeding; Mechanical Pruning; Fertilizing | NA | NA | NA |
| TREE NUTS | Chestnut, Pecan, Walnut | MRID 451382-02 | 2.5 | 100 | Orchard Maintenance; Poling; Hand Weeding | 1100 | 0 | 1100 |
| | | | | 190 | Mechanical Harvesting (shaking) | 560 | 2 | 1600 |
| | | | | 230 | Transplanting | 460 | 2 | 1300 |
| | | | | 580 | Scouting; Hand Pruning (full foliage) | 180 | 4 | 1400 |
| | | | | Use Alternate TC Method | Hand Pruning (minimum foliage); Mechanical Sweeping; Mechanical Windrowing | NA | NA | NA |
| | | | | NA | Irrigation (non-hand set); Mechanical Weeding | NA | NA | NA |
| TREE NUTS | Macadamia Nut | MRID 451382-02 | 0.94 | 100 | Orchard Maintenance | 2800 | 0 | 2800 |
| | | | | 190 | Mechanical Harvesting (shaking) | 1500 | 0 | 1500 |
| | | | | 230 | Transplanting | 1200 | 0 | 1200 |
| | | | | 580 | Scouting; Hand Pruning (full foliage) | 490 | 2 | 1400 |
| | | | | Use Alternate TC Method | Hand Pruning (minimum foliage); Mechanical Sweeping; Mechanical Windrowing | NA | NA | NA |
| | | | | NA | Irrigation (non-hand set) | NA | NA | NA |
| | | | 3.2 | 100 | Hand Weeding | 830 | 1 | 1400 |

| Table J.3. Summary of Postapplication Risk Assessment for Malathion-Malaoxon Using MRID 451382-02 Apples DFR Data + Oxon Estimates | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| **Crop Group** | **Use Site** | **DFR Source[a]** | **App Rate[b] lbai/A** | **Transfer Coeficient[c] ($cm^2$/hr)** | **Activity[c]** | **MOE[d] at Day 0** | **DAT when MOE>1000** | **MOE[d]** |
| UNASSIGNED : FORESTRY | Pine Seed Orchard | MRID 451382-02 | | 230 | Transplanting | 360 | 2 | 100 |
| | | | | 580 | Hand Pruning (full foliage); Scouting | 140 | 4 | 1100 |
| | | | | 1400 | Seed Cone Harvesting | 59 | 6 | 1300 |
| | | | | 1900 | Irrigation (hand set) | 44 | 7 | 1600 |
| | | | | 6700 | Seedling Harvesting | 12 | 9 | 1300 |
| | | | | Use Alternate TC Method | Hand Pruning (minimal foliage | NA | NA | NA |
| | | | | NA | Mechanical Harvesting; Mechanical Weeding; Burndown; Fertilizing | NA | NA | NA |
| UNASSIGNED : FORESTRY | Pine Seed Orchard | MRID 451382-02 | 0.94 ULV | 100 | Hand Weeding | 2800 | 0 | 2800 |
| | | | | 230 | Transplanting | 1200 | 0 | 1200 |
| | | | | 580 | Hand Pruning (full foliage); Scouting | 490 | 2 | 1400 |
| | | | | 1400 | Seed Cone Harvesting | 200 | 4 | 1600 |
| | | | | 1900 | Irrigation (hand set) | 150 | 4 | 1200 |
| | | | | 6700 | Seedling Harvesting | 42 | 7 | 1500 |
| | | | | Use Alternate TC Method | Hand Pruning (minimal foliage | NA | NA | NA |
| | | | | NA | Mechanical Harvesting; Mechanical Weeding; Burndown; Fertilizing | NA | NA | NA |

**NA**: Not Available – no known transfer coefficient for this activity, therefore, MOEs could not be calculated.

a. DFR Source: ARETF Malathion DFR studies were used to calculate DFR residues for malathion. Malaoxon residues were not measured in the studies, but were estimated to be 5% of the parent. Regressions were run to provide predicted malathion-malaoxon residues after treatment. Additionally, a 22x toxicity adjustment factor was applied to the estimated malaoxon residue to account for the additional toxicity of the oxon. Regression was run based on: Estimated DFR of Malathion-Malaoxon = malathion DFR + 22 X (0.05 malathion DFR)

- MRID 451382-02 Apple Study application rate = 1.25 lb ai/acre

b. Application rates are the maximum application rates determined from EPA registered labels for malathion.
c. Transfer Coefficient and Post Application Activities from EPA's Occupational Pesticide Re-entry Exposure Calculator – Revised March 2013.
d. MOE calculated using dermal dose and POD for malathion (80 mg/kg/day). Dermal Dose (mg/kg/day) = DFR (µg/cm$^2$) x 8 hr x transfer coefficient (cm$^2$/hr) / 1000 x body weight (69 kg). MOE = POD (mg/kg/day) / dermal dose (mg/kg/day. Level of Concern (LOC) = 1,000.

**Table J.4. Summary of Postapplication Risk Assessment for Malathion-Malaoxon Using MRID 450059-10 Grapes DFR Data + Oxon Estimates**

| Crop Group | Use Site | DFR Source[a] | App Rate[b] lbai/A | Transfer Coeficient[c] (cm$^2$/hr) | Activity[c] | MOE[d] at Day 0 | DAT when MOE>1000 | MOE[d] |
|---|---|---|---|---|---|---|---|---|
| BUNCH/ BUNDLE | Hop | MRID 450059-10 | 0.63 | 230 | Transplanting | 7600 | 0 | 7600 |
| | | | | 640 | Scouting; Hand Weeding; Tying/Training; Stripping | 2700 | 0 | 2700 |
| | | | | 1900 | Irrigation (hand set) | 920 | 1 | 1200 |
| | | | | 19300 | Mechanically-assisted Harvesting | 91 | 9 | 1000 |
| | | | | NA | Irrigation (non-hand set); Mechanical Weeding; Discing; Ditching | NA | NA | NA |
| VINE/ TRELLIS | Grape (wine and juice) | MRID 450059-10 | 1.88 | 230 | Transplanting | 2600 | 0 | 2600 |
| | | | | 640 | Bird Control; Trellis Repair; Propagating; Scouting; Hand Pruning; Hand Weeding | 920 | 1 | 1200 |
| | | | | 1900 | Irrigation (hand set) | 310 | 5 | 1200 |
| | | | | 10100 | Tying/Training; Hand Harvesting; Leaf Pulling | 58 | 11 | 1100 |
| | | | | NA | Irrigation (non-hand set); Mechanical Harvesting and Weeding; Burndown; Ditching; Mechanical Pruning | NA | NA | NA |
| VINE/ TRELLIS | Grape (raisin, table) | MRID 450059-10 | 1.88 | 230 | Transplanting | 2600 | 0 | 2600 |
| | | | | 640 | Hand Weeding: Hand Pruning; Scouting | 920 | 1 | 1200 |
| | | | | 1900 | Irrigation (hand set) | 310 | 5 | 1200 |
| | | | | 5500 | Tying/Training; Hand Harvesting; Leaf Pulling | 110 | 9 | 1200 |

| Table J.4. Summary of Postapplication Risk Assessment for Malathion-Malaoxon Using MRID 450059-10 Grapes DFR Data + Oxon Estimates | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| **Crop Group** | **Use Site** | **DFR Source[a]** | **App Rate[b] lbai/A** | **Transfer Coeficient[c] ($cm^2$/hr)** | **Activity[c]** | **MOE[d] at Day 0** | **DAT when MOE>1000** | **MOE[d]** |
| | | | | 19300 | Table only: Turning; Girdling | 3 | 13 | 1000 |
| | | | | NA | Irrigation (non-hand set) | NA | NA | NA |
| VINE/ TRELLIS | Blueberry (highbush), Currants | 450059-10 | 1.25 | 230 | Transplanting | 3800 | 0 | 3800 |
| | | | | 640 | Scouting; Hand Pruning; Hand Weeding; Bird Control; Frost Control | 1400 | 0 | 1400 |
| | | | | 1400 | Hand Harvesting | 630 | 2 | 1100 |
| | | | | 1900 | Irrigation (hand set) | 470 | 3 | 1000 |
| | | | | NA | Irrigation (non-hand set); Mechanical Harvesting; Mechanical Weeding | NA | NA | NA |
| VINE/ TRELLIS | Blueberry (highbush) | 450059-10 | 0.77 ULV | 230 | Transplanting | 6200 | 0 | 6200 |
| | | | | 640 | Scouting; Hand Pruning; Hand Weeding; Bird Control; Frost Control | 2200 | 0 | 2200 |
| | | | | 1400 | Hand Harvesting | 1000 | 0 | 1000 |
| | | | | 1900 | Irrigation (hand set) | 760 | 2 | 1300 |
| | | | | NA | Irrigation (non-hand set); Mechanical Harvesting; Mechanical Weeding | NA | NA | NA |
| VINE/ TRELLIS | Passion Fruit | MRID 450059-10 | 1 | 230 | Transplanting | 4800 | 0 | 4800 |
| | | | | 640 | Scouting; Hand Pruning; Hand Weeding; Tying/Training | 1700 | 0 | 1700 |
| | | | | 10100 | Hand Harvesting | 110 | 9 | 1200 |
| | | | | NA | Irrigation (non-hand set); Mechanical Weeding | NA | NA | NA |

**NA**: Not Available – no known transfer coefficient for this activity, therefore, MOEs could not be calculated.

a. DFR Source: ARETF Malathion DFR studies were used to calculate DFR residues for malathion. Malaoxon residues were not measured in the studies, but

were estimated to be 5% of the parent. Regressions were run to provide predicted malathion-malaoxon residues after treatment. Additionally, a 22x toxicity adjustment factor was applied to the estimated malaoxon residue to account for the additional toxicity of the oxon. Regression was run based on: Estimated DFR of Malathion-Malaoxon = malathion DFR + 22 X (0.05 malathion DFR)

- MRID 450059-10 Grape Study application rate = 1 lb ai/acre

b. Application rates are the maximum application rates determined from EPA registered labels for malathion.

c. Transfer Coefficient and Post Application Activities from EPA's Occupational Pesticide Re-entry Exposure Calculator – Revised March 2013.

d. MOE calculated using dermal dose and POD for malathion (80 mg/kg/day). Dermal Dose (mg/kg/day) = DFR (µg/cm$^2$) x 8 hr x transfer coefficient (cm$^2$/hr) / 1000 x body weight (69 kg). MOE = POD (mg/kg/day) / dermal dose (mg/kg/day. Level of Concern (LOC) = 1,000.

**Table J.5. Summary of Postapplication Risk Assessment for Malathion-Malaoxon Using MRID 454695-01 Nursery Stock DFR Data + Oxon Estimates**

| Crop Group | Use Site | DFR Source[a] | App Rate[b] lbai/A | Transfer Coeficient[c] (cm$^2$/hr) | Activity[c] | MOE[d] at Day 0 | DAT when MOE>1000 | MOE[d] |
|---|---|---|---|---|---|---|---|---|
| UNASSIGNED | Nursery (ornamentals, trees, container stock) - broadcast and ground directed | MRID 454695-01 | 0.25 | 230 | Hand Harvesting; Hand Pruning; Scouting; Container Moving; Hand Weeding: Transplanting; Grafting; Propagating; Pinching; Tying/Training | 9200 | 0 | 9200 |
| | | | | 1900 | Irrigation (hand set); | 1100 | 0 | 1100 |
| | | | | NA | Irrigation (non-hand set); Mechanical Weeding; Mechanical Harvesting; Fertilizing; Spreading Bins | NA | NA | NA |
| UNASSIGNED | Nursery (ornamentals, trees, container stock) - broadcast and ground directed | MRID 454695-01 | 1 | 230 | Hand Harvesting; Hand Pruning; Scouting; Container Moving; Hand Weeding: Transplanting; Grafting; Propagating; Pinching; Tying/Training | 2300 | 0 | 2300 |
| | | | | 1900 | Irrigation (hand set); | 280 | 3 | 1000 |
| | | | | NA | Irrigation (non-hand set); Mechanical Weeding; Mechanical Harvesting; Fertilizing; Spreading Bins | NA | NA | NA |

| Table J.5. Summary of Postapplication Risk Assessment for Malathion-Malaoxon Using MRID 454695-01 Nursery Stock DFR Data + Oxon Estimates | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| **Crop Group** | **Use Site** | **DFR Source[a]** | **App Rate[b] lbai/A** | **Transfer Coeficient[c] ($cm^2$/hr)** | **Activity[c]** | **MOE[d] at Day 0** | **DAT when MOE>1000** | **MOE[d]** |
| UNASSIGNED | Nursery (ornamentals, trees, container stock) - broadcast and ground directed | MRID 454695-01 | 10 | 230 | Hand Harvesting; Hand Pruning; Scouting; Container Moving; Hand Weeding: Transplanting; Grafting; Propagating; Pinching; Tying/Training | 230 | 4 | 1300 |
| | | | | 1900 | Irrigation (hand set); | 28 | 9 | 1300 |
| | | | | NA | Irrigation (non-hand set); Mechanical Weeding; Mechanical Harvesting; Fertilizing; Spreading Bins | NA | NA | NA |

**NA**: Not Available – no known transfer coefficient for this activity, therefore, MOEs could not be calculated.

a. DFR Source: ARETF Malathion DFR studies were used to calculate DFR residues for malathion. Malaoxon residues were not measured in the studies, but were estimated to be 5% of the parent. Regressions were run to provide predicted malathion-malaoxon residues after treatment. Additionally, a 22x toxicity adjustment factor was applied to the estimated malaoxon residue to account for the additional toxicity of the oxon. Regression was run based on: Estimated DFR of Malathion-Malaoxon = malathion DFR + 22 X (0.05 malathion DFR)
   - MRID 454695-01 Nursery Stock application rate = 1.3 lb ai/acre

b. Application rates are the maximum application rates determined from EPA registered labels for malathion.

c. Transfer Coefficient and Post Application Activities from EPA's Occupational Pesticide Re-entry Exposure Calculator – Revised March 2013.

d. MOE calculated using dermal dose and POD for malathion (80 mg/kg/day). Dermal Dose (mg/kg/day) = DFR (µg/$cm^2$) x 8 hr x transfer coefficient ($cm^2$/hr) / 1000 x body weight (69 kg). MOE = POD (mg/kg/day) / dermal dose (mg/kg/day. Level of Concern (LOC) = 1,000.

| Table J.6. Summary of Post-application Risk Assessment for Malathion-Malaoxon Using MRID 439450-01 Turf TTR Data + Oxon Estimates | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| **Crop Group** | **Use Site** | **TTR Source[a]** | **App Rate[b] lbai/A** | **Transfer Coeficient[c] ($cm^2$/hr)** | **Activity[c]** | **MOE[d] at Day 0** | **DAT when MOE>1000** | **MOE[d]** |
| TURF/SOD | Bermuda Grass | MRID 439450-01 | 1.25 | 6700 | Maintenance; Slab Harvesting; Transplanting; Planting | 310 | 1 | 1300 |

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | | | | NA | Roll Harvesting | NA | NA | NA |

**NA**: Not Available – no known transfer coefficient for this activity, therefore, MOEs could not be calculated.

a. TTR Source: Malathion TTR study was used to calculate TTR residues for malathion. Malaoxon residues were not measured in the studies, but were estimated to be 5% of the parent. Regressions were run to provide predicted malathion-malaoxon residues after treatment. Additionally, a 22x toxicity adjustment factor was applied to the estimated malaoxon residue to account for the additional toxicity of the oxon. Regression was run based on: Estimated TTR of Malathion-Malaoxon = malathion TTR + 22 X (0.05 malathion TTR)
   - MRID 439450-01 Turf Application Rate = 5.26 lbs ai/acre

b. Application rates are the maximum application rates determined from EPA registered labels for malathion.

c. Transfer Coefficient and Post Application Activities from EPA's Occupational Pesticide Re-entry Exposure Calculator – Revised March 2013.

d. MOE calculated using dermal dose and POD for malathion (80 mg/kg/day). Dermal Dose (mg/kg/day) = DFR ($\mu g/cm^2$) x 8 hr x transfer coefficient ($cm^2/hr$) / 1000 x body weight (69 kg). MOE = POD (mg/kg/day) / dermal dose (mg/kg/day. Level of Concern (LOC) = 1,000.

## Appendix K. Registered Label Summary for Malathion

| Table K.1. Summary of Registered Labels for Malathion | |
|---|---|
| Product Name/Formulation | Registration No |
| MALATHION 50% EC | 4-99 |
| BONIDE A COMPLETE FRUIT TREE SPRAY | 4-122 |
| BONIDE A COMPLETE FRUIT TREE SPRAY | 4-122 |
| BONIDE A COMPLETE FRUIT TREE SPRAY | 4-122 |
| BONIDE MALATHION INSECT SPRAY | 4-412 |
| ORTHO MALATHION 50 INSECT SPRAY | 239-739 |
| SA-50 BRAND MALATHION-OIL CITRUS & ORNAMENTAL SPRAY | 829-175 |
| SA-50 BRAND MALATHION-OIL CITRUS & ORNAMENTAL SPRAY | 829-175 |
| SA-50 MALATHION 50% E.C. | 829-282 |
| MAX KILL DUSTA-CIDE 6 | 1015-69 |
| MALATHION FOGGING SPRAY | 3862-28 |
| FYFANON TECHNICAL | 4787-5 |
| FYFANON ULV CONCENTRATE INSECTICIDE | 5905-112 |
| FYAFANON MALATHION INSECTICIDE | 5905-196 |
| FYFANON 8 LB. EMULSION | 5905-250 |
| HI-YIELD 55% MALATHION | 7401-10 |
| MALATHION 5 | 9779-5 |
| MALATHION 57% | 10088-56 |
| MALATHION 8 | 10163-21 |
| DREXEL MALATHION 5EC | 19713-217 |
| DREXEL MALATHION ULV INSECTICIDE | 19713-288 |
| GREEN DEVIL SPRAY | 19713-304 |
| DREXEL MALATHION 50% EMULSIFIABLE | 19713-330 |
| DREXEL MALATHION TECHNICAL | 19713-402 |
| DREXEL MALATHION ULV 96.5% | 19713-540 |
| UNICORN MALATHION SPRAY 1 | 28293-123 |
| ACME MALATHION 50% SPRAY | 33955-394 |
| MALATHION 57 EC | 34704-108 |
| MALATHION 8E INSECTICIDE | 34704-452 |
| MALATHION 8 AQUAMUL | 34704-474 |
| CLEAN CROP MALATHION ULV CONCENTRATE INSECTICIDE | 34704-565 |
| MALATHION TECHNICAL | 34704-787 |
| CHEM-TOX MAL 50%-E.C. | 45385-43 |
| CHEM-TOX MALATHION 3% | 45385-65 |
| CHEM-TOX MAL 50-OS | 45385-66 |
| SUPER K-GRO MALATHION 50 INSECT SPRAY | 46515-19 |
| PROZAP MALATHION 57% EMULSIFIABLE LIQUID INSECTICIDE-B | 47000-107 |
| MALATHION 5 EC | 66330-220 |
| FYFANON ULV MOSQUITO | 67760-34 |
| FYFANON ULV AG | 67760-35 |
| FYFANON 57% EC | 67760-40 |

| | |
|---|---|
| FYFANON PLUS ULV | 67760-108 |
| FYFANON PLUS ULV | 67760-108 |
| CHEMINOVA MALATHION 57% LOW VOC | 67760-119 |
| Malathion 851 g/L + Gamma-Cyhalothrin 12.8 g/L EC | 67760-131 |
| Malathion 851 g/L + Gamma-Cyhalothrin 12.8 g/L EC | 67760-131 |
| MALATHION-5 EMULSIFIABLE CONCENTRATE | 84009-6 |
| PRENTOX 5 LB. MALATHION SPRAY | 89459-36 |
| ORTHO MALATHION 25 WETTABLE | CA760166 |
| MALATHION ULV CONCENTRATE INSECTICIDE | CA830012 |
| MALATHION 8 | DE130002 |
| FYFANON ULV AG ULTRA LOW VOLUME CONCENTRATE INSECTICIDE | FL100004 |
| MALATHION 8 | FL130001 |
| FYFANON 57% EC | FL130002 |
| FYFANON ULV AG | FL130003 |
| FYFANON ULV AG | GA130002 |
| MALATHION 8 | GA130003 |
| MALATHION 8 | GA130004 |
| MALATHION 8 | IN130001 |
| MALATHION 8 | IN130002 |
| MALATHION 8 | KY140001 |
| FYFANON ULV AG | MA130001 |
| FYFANON 57% EC | MA130002 |
| MALATHION 8 | MA130003 |
| MALATHION 8 | MA130004 |
| MALATHION 8 | MD130003 |
| MALATHION 8 | MD130004 |
| MALATHION 8 | ME130001 |
| MALATHION 8 | MI130003 |
| MALATHION 8 | MI130005 |
| FYFANON ULV AG | MI140004 |
| MALATHION 5 EC | MN080002 |
| MALATHION 8 | MS130005 |
| FYFANON ULV AG | NC130006 |
| MALATHION 8 | NC130007 |
| MALATHION 8 | NC130008 |
| FYFANON 57% EC | NH130001 |
| FYFANON 57% EC | NH130002 |
| MALATHION 8 | NH130003 |
| MALATHION 8 | NH130004 |
| MALATHION 8 | NJ130003 |
| MALATHION 8 AQUAMUL | NJ130004 |
| FYFANON ULV AG | NJ130005 |
| FYFANON ULV AG | NJ130006 |
| FYFANON 57% EC | NJ130007 |
| FYFANON 57% EC | NJ130008 |
| FYFANON 57% EC | NJ130009 |
| MALATHION 8 | NJ130010 |
| MALATHION 8 AQUAMUL | NM140002 |
| FYFANON ULV AG | OR080024 |
| MALATHION 8 | OR130010 |
| MALATHION 8 | OR130011 |
| MALATHION 8 AQUAMUL | OR130013 |

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|---|---|
| MALATHION 8 | PA130005 |
| MALATHION 8 | PA130006 |
| FYFANON ULV AG | TX060018 |
| CLEAN CROP MALATHION ULV CONCENTRATE INSECTICIDE | TX950006 |
| MALATHION 8 | VA130006 |
| MALATHION 8 | VA130007 |
| MALATHION 8 | WA130004 |
| MALATHION 8 AQUAMUL | WA130010 |
| FYFANON ULV AG | WA960004 |
| | 11312-EUP-33 |
| | 11312-EUP-33 |
| | 11312-EUP-34 |
| | 11312-EUP-34 |
| | 34704-EUP-3 |