UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
WASHINGTON, D.C. 20460

OFFICE OF
PREVENTION, PESTICIDES AND
TOXIC SUBSTANCES

May 29, 2002

MEMORANDUM

SUBJECT: REVISED "OCCUPATIONAL AND RESIDENTIAL EXPOSURE AND RISK ASSESSMENT AND RECOMMENDATIONS FOR THE REREGISTRATION ELIGIBILITY DECISION DOCUMENT FOR METHYL PARATHION."

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THRU: Al Nielsen, Branch Senior Scientist
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Please find attached a revised occupational exposure and risk assessment for the use of methyl parathion. This revised edition contains data that were produced as a result of the memorandum of agreement between the primary methyl parathion registrants and the Agency, dated August 2, 1999. It also reflects the changes in labeling as a result of the memorandum of agreement.

DB Barcode: D283013

Pesticide Chemical Code: 053501

EPA Reg Numbers: 279-3222, 1812-431, 1812-432, 4581-393, 4787-33, 5905-533, 5905-534, 9779-362, 19713-322, 19713-324, 19713-511, 19713-512, 34704-818, 34704-819, 51036-321, 67760-39, and 67760-49.

MRID Numbers: 452001-01, 452047-01, 452697-01, 452697-02, 452750-01, 452837-01, 45295-01, 453174-01, 453271-01, 452889-01, 453592-01, 453677-01, 453915-01, 454009-01, 454490-01, 455024-01, 455130-01, 455276-01, and 455526-01

PHED: Yes, Version 1.1

Executive Summary

Methyl parathion, O, O-Dimethyl O-(4-nitrophenyl) phosphorothioate, is an acaricide and an insecticide registered for use on a variety of crops. It is a restricted use pesticide that is formulated as a microencapsulate (20.9 percent active ingredient), and an emulsifiable concentrate (ranges from 19.4 to 52.7 percent active ingredient). The application rates vary from 0.375 to 2.0 pounds active ingredient per acre depending upon the exposure scenario and crop.

Products containing methyl parathion are intended for occupational uses only. Methyl parathion is a restricted-use pesticide and is only available for retail sale to and for use by certified applicators (or persons under their direct supervision) and only for those uses covered by the certified applicator's certification. A few emulsifiable concentrate labels restrict the application of methyl parathion to enclosed cabs/cockpits only and most products are packaged Micromatic “DV” liquid transfer enclosed mixing/loading systems.

Methyl parathion is classified as acute toxicity category I for acute oral, dermal and inhalation exposures, acute toxicity category III for primary eye irritation, acute toxicity category IV for primary skin irritation and is not a skin sensitizer. The Methyl Parathion Hazard Identification Assessment Review Committee (HIARC) Report, dated March 23, 1999, determined a NOAEL of 0.11 mg/kg/day and 100% absorption were established for both the dermal and inhalation routes of exposure. The HIARC revisited the dermal endpoint decision made in 1999, since a new 28-day dermal study on methyl parathion was submitted to the Agency in 2002. A new dermal LOAEL was established at 0.30 mg/kg/day with an additional uncertainty factor of 3x to account for the use of a LOAEL instead of a NOAEL. An adjusted LOAEL of 0.1 mg/kg/day will be used to calculate dermal risks in this document (0.3 mg/kg/day divided by the 3x uncertainty factor). This value was used since the NOAEL from the oral study, which was previously used to determine the dermal endpoint and is still being used for the inhalation endpoint, is 0.11 mg/kg/day with 100% dermal absorption. Also, the biomonitoring data, which was submitted in support of methyl parathion, determines a total dose, not a route specific dose. With the inhalation NOAEL at 0.11 mg/kg/day and the dermal adjusted LOAEL being 0.1 mg/kg/day (0.3 mg/kg/day divided by the 3x uncertainty factor), a determination of the route of exposure from the biomonitoring studies is unnecessary since the values are very similar.

The Agency has determined that there are potential exposures to mixers, loaders, applicators, and other handlers during usual use-patterns associated with methyl parathion. Methyl parathion can be applied with aerial equipment, airblast sprayer (microencapsulated formulation only), chemigation (microencapsulated formulation only), and groundboom equipment. Based on the use patterns of methyl parathion, nineteen major exposure scenarios were identified consisting of mixing/loading both formulations, applying the microencapsulate formulation using groundboom sprayers, airblast sprayers, and aerial equipment, applying the emulsifiable concentration formulation using groundboom sprayers and aerial equipment, and flagging aerial opperations for both formulations. Five chemical specific biomonitoring studies exist for methyl paration. For the emulsifiable concentrate formulation, one mixer/loader study was conducted and for the microencapsulate formulation, two mixer/loader and two groundboom applicator studies were conducted. These studies have been reviewed by the Agency for compliance with OPPTS Series 875: Occupational and Residential Exposure Test Guidelines. Pesticide Handlers Exposure Database (PHED) was used to assess handler exposures for scenarios where chemical-specific monitoring data are not available. The exposure and risk values will also be shown using PHED unit exposure values for the scenarios that have chemical specific handler unit exposure data as a comparison, since the PHED data have more replicates.

For mixing/loading the emulsifiable concentrate formulation, all of the assessed scenarios have a risk of concern using PHED data. Using the chemical specific data, only one out of the four scenarios have a risk of concern at engineering controls, mixing/loading for aerial application using the 90th percentile study data. For mixing/loading the microencapsulate formulation, all of the assessed scenarios have a risk of concern using PHED data. Using the chemical specific data, three out of the four scenarios assessed have a risk of concern at the additional PPE level of exposure, mixing/loading for aerial/chemigation applications at the median and 90th percentile and mixing/loading for groundboom applications at the 90th percentile.

For applying the emulsifiable concentrate formulation, no chemical specific data were available and all scenarios assessed using PHED surrogate data have a risk of concern. For applying the microencapsulate formulation, all of the assessed scenarios have a risk of concern using PHED data. Using the chemical specific data for applying microencapsulate with a groundboom, there is a risk of concern at an application rate of 1 lb ai/acre and 200 acres per day. For flagging aerial spray applications, no chemical specific data was available for either formulation. Using the PHED surrogate data, there is a risk of concern at an application rate of 1 and 2 lb ai/acre and 350 acres per day.

The Agency has determined that there are potential postapplication exposures to individuals entering treated fields. Chemical specific DFR data exist for the emulsifiable concentrate formulation on cotton, corn and cabbage. Chemical specific DFR data exist for the microencapsulate formulation on cotton, corn and walnuts. Three postapplication biomonitoring studies on walnut harvesting, sweet corn hand harvesting, and cotton scouting, exist on the use of the microencapsulate formulation. The postapplication microencapsulate studies were done concurrently with the DFR studies in order to determine the transferability of the microencapsulate for the activity conducted in the studies. These studies have been reviewed by the Agency for compliance with OPPTS Series 875: Occupational and Residential Exposure Test Guidelines. The DFR data were extrapolated to all remaining crops. DFR data were taken at three sites for each crop tested for both formulations.

Transfer coefficients for the microencapsulate formulation were determined for corn harvesting, cotton scouting and walnut harvesting. The cotton scouting transfer coefficient was also used to determine exposures to the microencapsulate formulation from scouting on all applicable crops. The transfer coefficient for walnut harvesting was also used to determine exposures to the microencapsulate formulation from almond and pecan harvesting. Transfer coefficients determined from the Agricultural Reentry Task Force (ARTF) studies will be used for all microencapsulate postapplication scenarios that do not have specific transfer coefficients determined from the chemical specific studies and for all emulisifiable concentrate postapplication scenarios. In addition to the transfer coefficients, the risk resulting from the worker's exposure from entering the treated fields in the three biomonitoring postapplication microencapsulate studies was also calculated.

For short and intermediate term exposure to the emulsifiable concentrate formulation, the day after treatment when the calculated MOE equals or exceeds the target MOE of 100 (REI) ranges from 4 to 27 days. For short and intermediate term exposures to the microencapsulate formulation, the day after treatment when the calculated MOE equals or exceeds the target MOE of 100 (REI) ranges from 8 to 52 days. Occupational postapplication risks from dermal exposure are of concern. See Table 14 for a summary.

For the exposures resulting from the workers exposure from entering the treated fields in the three biomonitoring postapplication microencapsulate studies, corn harvesting is a risk of concern at both the average dose and the 90^{th} percentile dose and cotton scouting is a risk of concern at the 90^{th} percentile dose. For exposures from these studies that were extrapolated to an eight hour work day, corn harvesting and cotton scouting are a risk of concern at both the average dose.

OCCUPATIONAL AND RESIDENTIAL EXPOSURE AND RISK ASSESSMENT FOR THE USE OF METHYL PARATHION

In this document, which is for use in the Agency's development of the methyl parathion Reregistration Eligibility Decision Document (RED), HED presents the results of its occupational exposure and risk assessment for the use of methyl parathion.

An occupational and/or residential exposure assessment is required for an active ingredient if (1) certain toxicological criteria are triggered and (2) there is potential exposure to handlers (mixers, loaders, applicators, etc.) during use or to persons entering treated sites after application is complete.

Summary of Toxicity Concerns

Acute Toxicology Categories

Acute Toxicology Categories

The toxicological data base for methyl parathion is adequate and will support reregistration. Guideline studies for acute toxicity indicate that the technical grade of methyl parathion is classified as shown in Table 1 below.[25]

Table 1. Acute Toxicity Data

Guideline No.	Study Type	Results	Toxicity Category
81-1	Acute Oral (rat)	LD_{50} = 4.5-24 mg/kg	I
81-2	Acute Dermal (rat)	$LD_{50=}$ 6 mg/kg	I
81-3	Acute Inhalation (rat)	LC_{50} <0.163 mg/L (approximately 7 mg/kg)	I
81-4	Primary Eye Irritation	Irritation clear by 7 days	III
81-5	Primary Skin Irritation	Max. score=2.0; 72 h=0.5	IV
81-6	Dermal Sensitization	Negative	

Toxicological Endpoints of Concern

The Methyl Parathion Hazard Identification Assessment Review Committee Report, dated March 23, 1999, indicates that there are toxicological endpoints of concern for methyl parathion.[1] Dermal and inhalation endpoints of concern have been identified for short-term and intermediate-term exposure durations. A NOAEL of 0.11 mg/kg/day and 100% absorption were established for both the dermal and inhalation routes of exposure. The 100% dermal absorption value was used since there is not an acceptable dermal absorption study for the Agency to use. However, several oral and dermal studies in rats and rabbits that were compared and they give a sense of the differential ratio between the oral and dermal studies, and it is quite small. So, the Agency does not consider 100% to be unreasonable.[1] The Hazard Identification Assessment Review Committee Committee revisited the dermal endpoint decision made in 1999, since a new 28-day dermal study on methyl parathion was submitted to the Agency in 2002.[2] A new dermal LOAEL was established at 0.30 mg/kg/day with an additional uncertainty factor of 3x to account for the use of a LOAEL instead of a NOAEL. An adjusted LOAEL of 0.1 mg/kg/day will be used to calculate dermal risks in this document (0.3 mg/kg/day divided by the 3x uncertainty factor). This value was used since the NOAEL from the oral study, which was previously used to determine the dermal endpoint and is still being used for the inhalation endpoint, is 0.11 mg/kg/day with 100% dermal absorption. Also, the biomonitoring data, which were submitted in support of methyl parathion, determine a total dose, not a route specific dose. With the inhalation NOAEL at 0.11 mg/kg/day and the dermal adjusted LOAEL being 0.1 mg/kg/day (0.3 mg/kg/day divided by the 3x uncertainty factor), a determination of the route of exposure from the biomonitoring studies is unnecessary since the values are very similar. See Table 2 for a comparison of the two studies used to determine the dermal endpoint.

An uncertainty factor (UF) of 100 was applied to account for both interspecies extrapolation (10X) and intraspecies variability (10X). Target MOEs are 100 for occupational exposures (3x assigned to the short- and intermediate- term dermal endpoint was already accounted for by dividing the LOAEL of 0.3 mg/kg/day by 3 to determine an adjusted LOAEL of 0.1 mg/kg/day for use in the risk calculations).

Since both the dermal and inhalation endpoints were based on identical effects seen at the LOAEL, the MOEs were combined in this risk assessment to identify a total MOE for the short- and intermediate-term. Since short- and intermediate- term dermal and inhalation NOAELs are the same, only one set of risk numbers were calculated for both durations. No chronic exposure scenarios were identified.

Methyl paraoxon has been identified as a degradate of methyl parathion. This degradate was measured in the postapplication dislodgeable foliar residue (DFR) studies. Limited toxicity data presently exist for methyl paraoxon, therefore the methyl parathion toxicity data will be used to assess the risks to this degradate. Since the same toxicity data are being used to assess both chemicals, the residues for methyl parathion and methyl paraoxon were combined in the DFR studies.

Table 2. Methyl Parathion Hazard Endpoints and Uncertainty Factors.

Route / Duration	NOAEL (mg/kg/day)	Effect	Study	Uncertainty Factors	Comments
Dermal (short- and intermediate-term) **(2002 HIARC decision)**	0.10 (adjusted LOAEL)[a]	Inhibition of brain & RBC ChE	28-day dermal study	Interspecies: 10x Intraspecies: 10x Use of LOAEL: 3x	
Dermal (short- and intermediate-term) **(1999 HIARC decision)**	0.11	Neuropathology & inhibition of brain, plasma, & RBC ChE	1-year dietary rat study	Interspecies: 10x Intraspecies: 10x	100 percent dermal absorption.
Inhalation (short- and intermediate-term)	0.11	Neuropathology & inhibition of brain, plasma, & RBC ChE	1-year dietary rat study	Interspecies: 10x Intraspecies: 10x	100 percent inhalation absorption.

Footnote:

a Adjusted LOAEL (0.1 mg/kg/day) = LOAEL (0.3 mg/kg/day) divided by 3x uncertainty factor for the use of a LOAEL. Target MOE = 100

SUMMARY OF USE PATTERNS AND FORMULATIONS

Occupational use Products and Homeowner Use Products

At this time, products containing methyl parathion are intended for occupational uses. Methyl parathion is a restricted-use pesticide and is only available for retail sale to and for use by certified applicators (or persons under their direct supervision) and only for those uses covered by the certified applicator's certification.[1] There are no homeowner uses, however, residential exposure could occur via agricultural spray drift from the use of methyl parathion on adjacent fields.

Type of Pesticide/Targeted Pests

Methyl parathion, O, O-Dimethyl O-(4-nitrophenyl) phosphorothioate, is a broad spectrum acaricide and an insecticide registered for use on a variety of crops. The types of pests that methyl parathion is used to control include (but are not limited to) mites, fleas, thrips, weevils, beetles, midges, maggots, grasshoppers, stinkbugs, scale, whiteflies, aphids, caterpillars, worms, moths and loopers.

Formulation Types and Percent Active Ingredient

Methyl parathion, a restricted use pesticide, is formulated as a microencapsulate (20.9 percent active ingredient), and an emulsifiable concentrate (ranges from 19.4 to 52.7 percent active ingredient).[3] Methyl parathion's emulsifiable concentrate is also formulated with ethyl parathion, endosulfan, and malathion. Methyl parathion is registered by FMC, Griffin, Cerexagri, Cheminova, Helena Chemical Company, Agriliance, Drexel, Platte Chemical Company, and Micro Flo Co.

Registered Occupational Use Sites

This chapter includes all uses for methyl parathion on currently registered labels. The following crops are listed on the current labels:

Food, Forage, Feed and Fiber Crops: Alfalfa, barley, dried beans, cabbage, corn, cotton, grass forage/fodder/hay, hops, lentils, oats, onion, dried peas, rapeseed, rice, rye, soybeans, sugar beet, sunflower, sweet potato, wheat, and white potato.[1,2]

Nuts: Almond, pecan, and walnuts.

Application Rates

The following is a list of application rates from currently registered methyl parathion labels or reduced application rates agreed upon by the registrants (crops with reduced application rates are indicated in bold).

Microencapsulate formulation: Lentils, onions, peas (0.5 lb ai/acre); barley, oats, rice, **soybeans**, sweet potatoes, sweet corn, wheat (0.75 lb ai/acre); dried beans, corn, cotton (1 lb ai/acre); white potatoes (1.5 lb ai/acre); almonds, pecans and walnuts (2 lb ai/acre).

Emulsifiable concentrate formulation: Sugar beets (0.375 lb ai/acre); onions, corn, rapeseed (0.5 lb ai/acre); barley, oats, rice, **soybeans**, wheat, **cotton**, grass, rye (0.75 lb ai/acre); dried peas, **alfalfa**, hops, sunflower (1 lb ai/acre); dried beans, white potatoes, cabbage (1.5 lb ai/acre).

Methods and Types of Equipment Used for Mixing, Loading, and Application

Methyl parathion can be applied with aerial equipment, airblast sprayer (microencapsulated formulation only), chemigation (microencapsulated formulation only), and groundboom equipment. Application with backpack sprayer or other hand-held equipment is prohibited on some labels.

OCCUPATIONAL AND RESIDENTIAL EXPOSURE AND RISKS

Handler Scenarios

EPA has determined that there are potential exposures to mixers, loaders, applicators, and other handlers during usual use-patterns associated with methyl parathion. Based on the use patterns of methyl parathion, nineteen major exposure scenarios were identified (ME = microencapsulate formulation; EC = emulsifiable concentration formulation):

- (1a) mixing/loading liquids (EC and ME formulations) for aerial and chemigation application (PHED data);
- (1b) mixing/loading liquids (EC and ME formulations) for groundboom application (PHED data);
- (1c) mixing/loading liquids (EC and ME formulations) for airblast application (PHED data);
- (2a) mixing/loading liquids (EC formulation) for aerial application (study data, median);
- (2b) mixing/loading liquids (EC formulation) for aerial application (study data, 90%);
- (2c) mixing/loading liquids (EC formulation) for groundboom application (study data, median);
- (2d) mixing/loading liquids (EC formulation) for groundboom application (study data, 90%);
- (3a) mixing/loading liquids (ME formulation) for aerial and chemigation application (study data, median);
- (3b) mixing/loading liquids (ME formulation) for aerial and chemigation application (study data, 90%);
- (3c) mixing/loading liquids (ME formulation) for groundboom application (study data, median);
- (3d) mixing/loading liquids (ME formulation) for groundboom application (study data, 90%);
- (3e) mixing/loading liquids (ME formulation) for airblast application (study data, median);
- (3f) mixing/loading liquids (ME formulation) for airblast application (study data, 90%);
- (4) applying sprays (EC and ME formulations) with aerial equipment (PHED data);

- (5) applying sprays (EC and ME formulations) with a groundboom sprayer (PHED data);
- (6a) applying sprays (ME formulation) with a groundboom sprayer (study data, geometric mean);
- (6b) applying sprays (ME formulation) with a groundboom sprayer (study data, 90%);
- (7) applying sprays (ME formulation) with airblast sprayer (PHED data); and
- (8) flagging sprays (ME and EC formulations) for aerial spray applications (PHED data).

Current Label PPE

Current label PPE for handlers includes coveralls over long sleeved shirt and long pants, waterproof or chemical resistant gloves, chemical resistant footwear plus socks, protective eye wear, and chemical resistant headgear to protect against overhead exposure. For exposure in enclosed areas, a respirator with an organic vapor removing cartridge with a prefilter or canister approved for pesticides is required. For outdoor exposures, a dust/mist filtering respirator is required. Some labels also require a chemical resistant apron when cleaning equipment or mixing/loading the product. A few emulsifiable concentrate labels also restrict the application of methyl parathion to enclosed cabs/cockpits only and prohibit human flaggers. Most emulisifiable concentrate products are packaged Micromatic "DV" liquid transfer enclosed mixing/loading systems.

Handler Exposure Data

Chemical Specific Data

Chemical specific handler data were submitted by Cheminova and Cerexagri according to the requirements stated in the memorandum of agreement between the primary methyl parathion registrants and the Agency, dated August 2, 1999. Cheminova submitted one biomonitoring mixer/loader study in support of the emulsifiable concentrate formulation (scenarios 2a/b/c/d) . Cerexagri submitted two biomonitoring mixer/loader studies and two biomonitoring groundboom application studies in support of the microencapsulate formulation (scenarios 3a/b/c/d/e/f; and scenario 6a/b). These studies have been reviewed by the Agency for compliance with OPPTS Series 875: Occupational and Residential Exposure Test Guidelines. All workers who participated in the biomonitoring studies read and signed Informed Consent forms, which explained the purpose of the study, the procedures, and a statement of their rights. A brief summary of the studies and any important issues follow. In depth reviews of each submitted study used in this assessment can be found in the individual Agency study reviews, as cited on the reference page at the end of this assessment.

Mixer/Loader studies

"*Biological Monitoring of Workers Mixing and Loading a 4 lb/gallon Emulsifiable Concentrate Formulation of Methyl Parathion for Aerial Application (Using a MICRO MATIC 'DV' Liquid Transfer Valve System)*" MRID # 455276-01[4]

The purpose of this study was to quantify potential exposure of mixers/loaders from the use of methyl parathion in the emulsifiable concentrate formulation packaged in a micromatic "DV" closed liquid transfer valve system, at three aerial application facilities. The facilities were located in Texas, Georgia, and Arkansas. Cheminova Methyl Parathion 4EC was mixed and pumped into aircraft using. Each test subject mixed and loaded test substance to support target aerial applications of 1200 acres of wheat and cotton. The application rate used in this study was 0.75 lbs a.i./acre. The mixer/loaders also performed clean-up activities at all three sites. Fifteen trained volunteer mixer/loaders were monitored for exposure via urinary analyses. This study included a total of sixteen replicates, with one worker performing two replicates. Methyl parathion exposure was quantified by measuring total 4-nitrophenol (4NP) in urine samples. The samples were also analyzed for creatinine content. Twenty-four hour urine samples were collected for 48 hours prior, through 72 hours after, exposure. The workers were sequestered in a hotel during this period, leaving only to perform mixing/loading operations.

For most replicates, test subjects wore personal protective equipment (PPE) during the mixing/loading, as prescribed on the product label. The PPE worn by the test subjects was as follows: coveralls over long-sleeved shirt and long pants, chemical resistant gloves, chemical resistant footwear and socks, protective eye wear, chemical-resistant apron; and dust/mist filtering half-face respirator (MSHA/NIOSH approval number prefix TC-21C). According to the study author, one worker at the Texas site (Replicate 3) did not wear a chemical resistant apron, due to oversight. The raw data were corrected for the following field recovery values: 75.3% for the Texas site, 79.4% for the Georgia site, 76% for the Arkansas site. In this study, the study authors corrected the field recovery values for laboratory recoveries. However, the raw data were not corrected for laboratory recovery values, therefore the field recovery values used in this assessment were left uncorrected for laboratory recovery values by HED. The uncorrected field recovery values take into account residue losses from the field, transport, storage, and analytical method, since the field recovery samples travel with and are analyzed with the field samples. The study was in compliance with OPPTS Series 875 Occupational and Residential Exposure Test Guidelines and is considered to be of sufficient scientific quality to be used in determining handler exposure to methyl parathion.

"*Occupational Exposure Monitoring of Mixing/Loading Activities for Aerial Application of PENNCAP M® Microencapsulated Insecticide Utilizing Biological Monitoring*" MRID #455130-01[5]

The purpose of this study was to quantify potential exposure of mixer/loader using an open system to mix and load methyl parathion, in the microencapsulated formulation. Enough methyl parathion was mixed and loaded to support aerial applications which were made to a variety of crops (including cotton, corn, soybeans, grain sorghum, and rice) in two geographical locations (Newport, Arkansas and Washington, Louisiana). PENNCAP-M® was applied using an airplane at the maximum application rate of 1.0 lb ai/A. Each test subject applied PENNCAP-M® to either 345 or 360 acres.

Ten volunteer mixer/loaders were monitored via urinary analyses. Methyl parathion exposure was quantified by measuring total 4-nitrophenol (4-NP) in urine samples. The samples were also analyzed for creatinine content. Twenty-four hour urine samples were collected for 48 hours prior, through 96 hours after, exposure. The workers were sequestered in a hotel during this period, leaving only to perform mixing/loading activities.

During the mixing and loading operation, participants wore personal protective equipment (PPE) similar to that prescribed on the product label. The following PPE was worn by the participants: cotton coveralls over long-sleeved shirt, undershirt, and long pants, chemical resistant boots, long nitrile gloves, fullface shield, dust/mist filtering half-face respirator (MSHA/NIOSH approval number prefix TC-21C), chemical resistant nitrile apron, and a Tyvek® hat. The raw data were corrected for the following field recovery values: 75% for the Arkansas site and 73.2% for the Louisiana site. In this study, the study authors corrected the field recovery values for laboratory recoveries. However, the raw data were not corrected for laboratory recovery values, therefore the field recovery values used in this assessment were left uncorrected for laboratory recovery values by HED. The uncorrected field recovery values take into account residue losses from the field, transport, storage, and analytical method, since the field recovery samples travel with and are analyzed with the field samples. Data from this study were combined with data from another mixer/loader study using PENNCAP-M® in Arizona and Mississippi (MRID # 453271-01). The PPE worn in this study was similar to the PPE worn in the AZ and MI study. Some replicates in both studies wore chemical resistant aprons and other additional PPE. The unit exposure values from the replicates wearing the additional PPE were not substantially different than the ones without, and in some cases they were higher. Therefore, all of the replicates from both studies were combined, assuming that the extra PPE (headgear, aprons) resulted in no quantitative difference in the unit exposure numbers from these two studies. The study was in compliance with OPPTS Series 875 Occupational and Residential Exposure Test Guidelines and is considered to be of sufficient scientific quality to be used in determining handler exposure to methyl parathion.

"*Occupational Exposure Monitoring of Aerial Mixing/Loading of PENNCAP M® Utilizing Biological Monitoring*" MRID # 453271-01[6]

The purpose of this study was to quantify potential exposure of mixer/loaders using an open system to mix and load methyl parathion in the microencapsulate formulation, at three aerial application facilities. The facilities were located in Greenville, MS; Gila Bend, AZ; and Harquahala, AZ. PENNCAP-M® Microencapsulated Insecticide was mixed and pumped into aircraft. Each test subject mixed and loaded sufficient test substance to support aerial application of 350 acres with an application rate of 1.0 lb ai/A. The mixer/loaders also performed clean-up activities at all three sites.

Fifteen experienced volunteer mixer/loaders were monitored via urinary exposure analyses. Urine samples were collected from five subjects at each location and at one location inhalation exposure was also monitored. Methyl parathion exposure was quantified by measuring total 4-nitrophenol and its sulfate and glucuronide conjugates in urine samples (the analytical method hydrolyzes these conjugates to 4-nitrophenol equivalents). The samples were also analyzed for creatinine content. Twenty-four hour urine samples (collected as 12 hour samples) were collected for 48 hours prior through 84 hours after exposure, or 5.5 days total. The workers were sequestered in a hotel during this period, leaving only to perform mixing/loading operations on the day of exposure.

At the Greenville, Mississippi and Gila Bend, Arizona sites (11 replicates), test subjects wore personal protective equipment (PPE) while mixing/loading as prescribed on the product label: long-sleeved shirt and long pants underneath coveralls, socks and rubber boots, protective gloves (neoprene), plastic goggles, and dust/mist filtering respirator. At the Harquahala Valley, Arizona site (5 replicates), test subjects wore the same PPE as previously listed with the following modifications: nitrile, instead of neoprene, protective gloves, face shield, instead of goggles, chemical resistant apron, and Tyvek® rain type hat. The raw data were corrected for the following field recovery values: 76.25% for the Mississippi site and 86.7% for the Gila Bend, AZ site. The Harquahala Valley, Arizona site had an average field recovery value of 95% and the data was therefore not corrected. In this study, the study authors corrected the field recovery values for laboratory recoveries. However, the raw data were not corrected for laboratory recovery values, therefore the field recovery values used in this assessment were left uncorrected for laboratory recovery values by HED. The uncorrected field recovery values take into account residue losses from the field, transport, storage, and analytical method, since the field recovery samples travel with and are analyzed with the field samples. Data from this study were combined with data from another mixer/loader study using PENNCAP-M® in Arkansas and Louisiana (MRID # 455130-01). The PPE worn in this study was similar to the PPE worn in the AR and LA study. Some replicates in both studies wore chemical resistant aprons and other additional PPE. The unit exposure values from the replicates wearing the additional PPE were not substantially different than the ones without, and in some cases they were higher. Therefore, all of the replicates from both studies were combined, assuming that the extra PPE (headgear, aprons) resulted in no quantitative difference in the unit exposure numbers from these two studies.

The study was in compliance with most of the OPPTS Series 875 Occupational and Residential Exposure Test Guidelines. The following issues of potential concern were identified:

- Creatinine levels were very low on the day after exposure in one worker at the Greenville, MS site, relative to the other workers.

Application studies

"*Biomonitoring Assessment of Worker Exposure to Methyl Parathion During Application to Potatoes Using Penncap-M® Microencapsulated Insecticide*" MRID # 454490-01[7]

The purpose of this interim study was to quantify potential exposure of from the use of methyl parathion in the microencapsulate formulation, while applying it to potatoes using an open cab ground application equipment. The facilities were located at three farms in Florida (St. Augustine, Hastings, and Elkton). The biomonitoring of groundboom sprayer applicators also occurred at two other sites, in addition to the Florida site. The data from these sites was provided in another report (MRID # 455024-01). PENNCAP-M® Microencapsulated Insecticide was applied using a standard tractor equipped with a groundboom sprayer. Each volunteer applied 2,565 gallons of the diluted spray mixture to a 200 acre potato field with an application rate of 1.5 lbs ai/A.

Five experienced volunteer applicators were monitored via urinary analyses. Methyl parathion exposure was quantified by measuring total 4-nitrophenol in urine samples. The samples were also analyzed for creatinine content. Twenty-four hour urine samples were collected for 48 hours prior, through 96 hours after, exposure. The workers were sequestered in a hotel during this period, leaving only to perform application activities. Test subjects wore the following personal protective equipment (PPE) during the application, as prescribed on the product label: long-sleeved shirt and long pants underneath coveralls; waterproof gloves; chemical-resistant footwear plus socks; protective eye wear; chemical-headgear for overhead exposure; and dust/mist filtering respirator (MSHA/NIOSH approval number prefix TC-21C). The raw data for the Florida site were corrected for a field recovery value of 75.9%. In this study, the study authors corrected the field recovery values for laboratory recoveries. However, the raw data were not corrected for laboratory recovery values, therefore the field recovery values used in this assessment were left uncorrected for laboratory recovery values by HED. The uncorrected field recovery values take into account residue losses from the field, transport, storage, and analytical method, since the field recovery samples travel with and are analyzed with the field samples. Data from this study were combined with data from another applicator study using PENNCAP-M® in Washington and Wisconsin (MRID # 455024-01). The same PPE was worn for all the replicates at all of the sites, Florida, Washington and Wisconsin. The study was in compliance with OPPTS Series 875 Occupational and Residential Exposure Test Guidelines and is considered to be of sufficient scientific quality to be used in determining handler exposure to methyl parathion.

"*Biomonitoring Assessment of Worker Exposure to Methyl Parathion During Application to Potatoes Using Penncap-M® Microencapsulated Insecticide*" MRID # 455024-01[8]

The purpose of this study was to quantify potential exposure of applicators from the use of methyl parathion in the microencapsulated formulation. Fifteen ground spray applications using an open cab tractor were made to potatoes in three geographical locations (three farms in Florida, three farms in

Washington, and one farm in Wisconsin). The data from the Florida site was submitted in a separate report, and the data from that site were previously reviewed (MRID 45449001, D276386). PENNCAP-M® (a flowable aqueous suspension containing packaged in 2.5 gallon containers) was applied using an open-cab tractor at the maximum label application rate of 1.5 lbs ai/A. Each test subject applied PENNCAP-M® to approximately 200 acres. For each of the three geographical locations, five experienced volunteer applicators were monitored via urinary analyses. Methyl parathion exposure was quantified by measuring total 4-nitrophenol (4-NP) in urine samples. The samples were also analyzed for creatinine content. Twenty-four hour urine samples were collected for 48 hours prior, through 96 hours after exposure. The workers were sequestered in a hotel during this period, leaving only to perform application activities.

Test subjects wore personal protective equipment (PPE) during the application, as prescribed on the product label: coveralls over long-sleeved shirt and long pants, chemical resistant gloves, socks, and footwear, protective eye wear, chemical-headgear for overhead exposure; and dust/mist filtering half-face respirator (MSHA/NIOSH approval number prefix TC-21C). The raw data were corrected for the following field recovery values: 85.1% for the Washington site, 79.9% for the Wisconsin site. In this study, the study authors corrected the field recovery values for laboratory recoveries. However, the raw data were not corrected for laboratory recovery values, therefore the field recovery values used in this assessment were left uncorrected for laboratory recovery values by HED. The uncorrected field recovery values take into account residue losses from the field, transport, storage, and analytical method, since the field recovery samples travel with and are analyzed with the field samples. Data from this study were combined with data from another applicator study using PENNCAP-M® in Florida (MRID 454490-01). The same PPE was worn for all the replicates at all of the sites, Florida, Washington and Wisconsin. The study was in compliance with OPPTS Series 875 Occupational and Residential Exposure Test Guidelines and is considered to be of sufficient scientific quality to be used in determining handler exposure to methyl parathion.

Surrogate Data

Chemical specific handler data does not exist for several of the identified handler scenarios, including application of sprays with aerial equipment, an airblast sprayer (ME formulation only) and a groundboom sprayer (EC formulation only). It is the policy of the HED to use data from the Pesticide Handlers Exposure Database (PHED) Version 1.1 to assess handler exposures for regulatory actions when chemical-specific monitoring data are not available.[9] The exposure and risk values will also be shown using PHED unit exposure values for the scenarios that have chemical specific handler unit exposure data (mixing/loading the EC and ME formulations and applying the ME formulation with a groundboom sprayer) as a comparison, since the PHED data have more replicates.

PHED was designed by a task force of representatives from the U.S. EPA, Health Canada, the California Department of Pesticide Regulation, and member companies of the American Crop Protection Association. PHED is a software system consisting of two parts -- a database of measured exposure values for workers involved in the handling of pesticides under actual field conditions and a set of computer algorithms used to subset and statistically summarize the selected data. Currently, the database contains values for over 1,700 monitored individuals (i.e., replicates)

Users select criteria to subset the PHED database to reflect the exposure scenario being evaluated. The subsetting algorithms in PHED are based on the central assumption that the magnitude of handler exposures to pesticides are primarily a function of activity (e.g., mixing/loading, applying), formulation type (e.g., wettable powders, granulars), application method (e.g., aerial, groundboom), and clothing scenarios (e.g., gloves, double layer clothing).

Once the data for a given exposure scenario have been selected, the data are normalized (i.e., divided by) by the amount of pesticide handled resulting in standard unit exposures (milligrams of exposure per pound of active ingredient handled). Following normalization, the data are statistically summarized. The distribution of exposure values for each body part (e.g., chest, upper arm) is categorized as normal, lognormal, or "other" (i.e., neither normal nor lognormal). A central tendency value is then selected from the distribution of the exposure values for each body part. These values are the arithmetic mean for normal distributions, the geometric mean for lognormal distributions, and the median for all "other" distributions. Once selected, the central tendency values for each body part are composited into a "best fit" exposure value representing the entire body.

The unit exposure values calculated by PHED generally range from the geometric mean to the median of the selected data set. To add consistency and quality control to the values produced from this system, the PHED Task Force has evaluated all data within the system and has developed a set of grading criteria to characterize the quality of the original study data. The assessment of data quality is based on the number of observations and the available quality control data. While data from PHED provide the best available information on handler exposures, it should be noted that some aspects of the included studies (e.g., duration, acres treated, pounds of active ingredient handled) may not accurately represent labeled uses in all cases. HED has developed a series of tables of standard unit exposure values for many occupational scenarios that can be utilized to ensure consistency in exposure assessments.[10]

Handler Exposure Assumptions

The following general assumptions are made:

- Average body weight of an adult handler is 70 kg.

- Average work day interval represents an 8 hour workday (the acres treated or volume of spray solution prepared in a typical day).

- Due to a lack of some scenario-specific data, HED sometimes calculates unit exposure values using generic protection factors that are applied to represent the use of personal protective equipment (PPE) and engineering controls. This assessment used a 50 percent protection factor to account for a double layer of clothing, and a 80 percent protection factor over baseline unit exposure values to represent the use of a dust/mist respirator. A 98 percent protection factor was used to estimate closed truck engineering control for flagger exposure.

- Additional PPE level of mitigation was assessed with a worker wearing a double layer of clothes, gloves and a dust/mist respirator, since this is the PPE listed on current labels. This level of PPE was also chosen since it is the level of PPE worn in the chemical specific studies, therefore making the PHED data comparable to the study data.

- The unit exposure data calculated from the chemical specific studies are total unit exposures, taking into account all routes of exposure to methyl parathion (dermal + inhalation). In the handler tables, the total unit exposure values are listed under the dermal exposure columns and the use of a total unit exposure value is noted.

- Daily (8-hour workday) acres and volumes (as appropriate) to be treated in each scenario include:[11]

– A range of the possible number of acres that can be treated with methyl parathion aerially on cotton, small grains (wheat, barley, oats and rye), corn, rice, soybeans, and alfalfa in one day are given in this assessment for risk mitigation decision purposes. Exposures were estimated for handlers using 1,200 and 350 acres per day for aerial equipment. The use of 1,200 acres treated in one day by either the mixer/loader or the applicator is considered a reasonable high end estimate, because these crops are high acreage field crops. This maximum acres treated aerially per day is based on published scientific literature, surveys, knowledge of agricultural practices, and calculated acreage estimates.[11]

-- 350 acres for aerial and chemigation applications, including flaggers supporting aerial applications;

-- For groundboom equipment use on cotton, small grains (wheat, barley, oats and rye), soybeans, rice, alfalfa and corn, since they are large acreage crops, a range of 200 acres per day to 80 acres per day was used. For all other crops, 80 acres were used.

-- 40 acres for airblast applications

- For comparison, in the handler studies conducted with methyl parathion, the average time it took to mix and load enough product to aerially treat 1089 acres with the emulsifiable concentrate formulation, using the closed loading system, was 2 hours and 12 minutes. The average time it took to mix and load enough product to aerially treat 350 acres with the microencapsulate formulation was 1 hour and 24 minutes and the average time it took to aerially treat 200 acres with the microencapsulate formulation using a groundboom was 7 hours and 48 minutes.

- The duration of exposure for handlers of methyl parathion is assumed to be short-and intermediate-term (one day to one month; one month to several months). Since methyl parathion is applied to several large acre crops, it is assumed that a professional pesticide applicator could apply methyl parathion for over one month, therefore; intermediate term handler exposure was assessed.

Handler Exposure Calculations

Handler exposure assessments were completed using a baseline exposure scenario and, if required, increasing levels of risk mitigation (PPE and engineering controls) in an attempt to achieve an appropriate margin of exposure. The baseline scenario generally represents a handler wearing long pants, a long-sleeved shirt, no respirator, and no chemical-resistant gloves.

Potential daily dermal exposure is calculated using the following formula:

$$\text{Daily Dermal Exposure}\left(\frac{mg\ ai}{day}\right) = \text{Unit Exposure}\left(\frac{mg\ ai}{lb\ ai}\right) \times \text{Use Rate}\left(\frac{lb\ ai}{A}\right) \times \text{Daily Acres Treated}\left(\frac{A}{day}\right)$$

Potential daily inhalation exposure is calculated using the following formula:

$$\text{Daily Inhalation Exposure}\left(\frac{mg\ ai}{day}\right) = \text{Unit Exposure}\left(\frac{\mu g\ ai}{lb\ ai}\right) \times \text{Conversion Factor}\left(\frac{1 mg}{1{,}000\ \mu g}\right) \times \text{Use Rate}\left(\frac{lb\ ai}{A}\right) \times \text{Daily Acres Treated}\left(\frac{A}{day}\right)$$

The daily dermal and inhalation dose is calculated using a 70 kg body weight for both short-term and intermediate-term exposure as follows:

$$\text{Daily Inhalation Dose}\left(\frac{mg\ ai}{kg/day}\right) = \text{Daily Inhalation Exposure}\left(\frac{mg\ ai}{day}\right) \times \left(\frac{1}{\text{Body Weight (kg)}}\right)$$

$$\text{Daily Dermal Dose}\left(\frac{mg\ ai}{Kg/Day}\right) = \text{Daily Dermal Exposure}\left(\frac{mg\ ai}{Day}\right) x \left(\frac{1}{\text{Body Weight (Kg)}}\right)$$

These calculations of both the daily dermal dose and the daily inhalation dose of methyl parathion received by handlers are used to assess the total risk to handlers. The short-term and intermediate-term inhalation MOEs were calculated using a NOAEL of 0.11 mg/kg/day. The short-term and intermediate-term dermal MOEs were calculated using a adjusted LOAEL of 0.10 mg/kg/day (LOAEL of 0.30 mg/kg/day divided by 3x). The following formula describes the calculation of dermal and inhalation MOEs:

$$\text{Dermal MOE} = \frac{\text{Adjusted LOAEL}\left(\frac{mg}{kg/day}\right)}{\text{Dermal Daily Dose}\left(\frac{mg}{kg/day}\right)}$$

$$\text{Inhalation MOE} = \frac{\text{NOAEL}\left(\frac{mg}{kg/day}\right)}{\text{Inhalation Daily Dose}\left(\frac{mg}{kg/day}\right)}$$

Since the dermal and inhalation endpoints have similar effects seen at the LOAEL, then the dermal and inhalation MOEs should be combined, resulting in a total MOE value. The target MOE value for methyl parathion is 100 (3x assigned to the short and intermediate term dermal endpoint was already accounted for by dividing the LOAEL of 0.3 mg/kg/day by 3 to determine an adjusted LOAEL of 0.1 mg/kg/day for use in the risk calculations).

$$\text{Total MOE} = \frac{1}{\left(\frac{1}{\text{dermal MOE}}\right) + \left(\frac{1}{\text{inhalation MOE}}\right)}$$

Chemical Specific Handler Data Analysis

Unit exposure values were calculated by HED from the five chemical specific handler studies previously mentioned. The amount of methyl parathion that a worker was exposed to was determined by the amount of the methyl parathion metabolite, four (or para) nitrophenol (4NP) found in the workers' urine. The raw data (which consisted of the amount of 4NP found in a 24 hour urine sample) were corrected for four parameters: 1) field recovery data, 2) creatinine content, 3) molecular weight, and 4) metabolism of methyl parathion to 4NP in the body. The corrections for these parameters are explained below.

Field Recovery

The raw data for each individual test site were corrected for the field recoveries measured at that site if the recoveries were below 90%. The field recoveries measured at each fortification level tested were averaged together for a total field recovery found for each site. In some studies, the study authors corrected the field recovery values for laboratory recoveries. However, the raw data were not corrected for laboratory recovery values, therefore the field recovery values used in this assessment were left uncorrected for laboratory recovery values by HED. The uncorrected field recovery values take into account residue losses from the field, transport, storage, and analytical method, since the field recovery samples travel with and are analyzed with the field samples.

Creatinine Content

Creatinine is formed by the metabolism of creatine, which is found in muscle tissue and blood and is normally excreted in the urine as a metabolic waste product. Creatinine is usually excreted at a relatively constant rate per day for an individual, regardless of daily urine volume. Therefore, if daily creatinine values remain relatively constant for a worker over the study period, then it is assumed that none of the urine voids were lost and the samples are complete. The average person excretes 1.0 to 1.6 grams of creatinine per day.[24] A few of the daily creatinine levels found in the studies for the workers were very low compared to the average person (0.3 grams/day from study 45204701, worker 10), especially on the day of exposure. The creatinine values for the same worker over the study period were also variable, with one worker (#5 from study 45367701), for example, ranging from below 3 g/day to over 5 g/day during the study period. The low creatinine values in some samples and the variability of individual creatinine values during the study period may be the result of lost urine voids during the study period. Therefore, HED corrected the 4NP values for daily creatinine output in order to compensate for any possible loss of urine.

Molecular Weight

The data were also corrected for the molecular weight differences in methyl parathion and 4NP. The molecular weight of methyl parathion is 263 mass units, while the molecular weight of 4NP is 139 mass units. In the body, one molecule of methyl parathion is metabolized into one molecule of 4NP. Therefore, to determine the quantity of absorbed methyl parathion corresponding to the quantity of 4NP excreted, it is necessary to multiply by the ratio of the molecular weights, which for these studies was determined to be 1.89 (263 mass units of methyl parathion/139 mass units of 4NP).

Metabolism of Methyl Parathion into 4NP

The data were also corrected for the metabolism of methyl parathion into its metabolite, para nitro phenol (4NP). A metabolism study of methyl parathion in rats was conducted to determine how much of a dermally applied dose of methyl parathion is excreted in the urine.[12] In a dermal metabolism study, approximately 80% of the applied radioactivity was recovered in the urine, and approximately 90% of the radioactivity in the urine was determined to be excreted as PNP. Multiplying these two proportions, it was determined that approximately 72% of the applied dose of methyl parathion was excreted as urinary PNP. This factor was used to estimate exposure to methyl parathion, based on excreted para-Nitrophenol (4NP) as determined in the biomonitoring studies. The study was conducted for ten hours.

Method to Determine Unit Exposure Values

Twenty four hour urine samples were taken for each worker two weeks before the study began (prescreen), two and one day before the exposure event, the day of exposure, and either two or three days after exposure. In order to determined handler exposures and risks resulting from the study data, the raw 4NP values found in each 24 hour urine sample must be converted into the amount of methyl parathion that each worker was exposed to using the four parameters discussed above. Then, these individual exposure values must be averaged into a single exposure value for each possible exposure scenario. The 4NP raw data were corrected and averaged according to the following steps:

1) The raw daily 4NP values were corrected for field recovery, if the field recovery for that site was below 90%.

2) The data were then corrected for creatinine values by first dividing each daily 4NP value by that day's creatinine value.

3) An average creatinine value for each worker was then determined by averaging that worker's daily creatinine values for the duration of the study.

4) Each daily 4NP value divided by that day's creatine value, as determined in step 2, was then multiplied by the average creatinine value of that worker, as determined in step 3. This results in a total µg 4NP value for that day normalized for creatinine content.

5) The baseline level of 4NP in the workers is the amount of 4NP the was present in the worker's urine before the exposure event. This baseline level was determined by averaging the 4NP levels from the two days prior to exposure.

6) After the baseline 4NP level was determined for each worker, it was subtracted out of the daily 4NP amounts from the day of exposure and for each day after exposure. This was done to obtain the amount of 4NP that result only from the methyl parathion exposure in the study. If the baseline 4NP level was greater than the 4NP level found on that day, that day's 4NP level was recorded as a zero.

7) The 4NP levels from the day of exposure and each day after the exposure event, from step 6, were added together to determine a total 4NP value that resulted from the exposure event.

8) This total 4NP value was then corrected for molecular weight by multiplying by 1.89 mass unit methyl parathion/mass unit 4NP, as explained in the previous section.

9) Then the total 4NP value was corrected for the metabolism of methyl parathion into 4NP in the body by multiplying by (100 4NP/72 methyl parathion) = 1.39. (72% of methyl parathion is excreted to 4NP). This results in a total methyl parathion exposure in µg per worker.

10) The total methyl parathion exposure is then divided by the amount of active ingredient that the workers handled during their exposure in pounds ai. The result was a µg ai/lb ai unit exposure value for each worker.

11) The statistical distribution of this data was then determined using the *W* test, developed by Shapiro and Wilk. If the data were determined to be lognormally distributed, then the geometric mean was used. If the data were determined to be normally distributed, then the arithmetic mean was used and if the data were neither log normally or normally distributed, then the median was used.

12) The 90^{th} percentile of the data distribution was also determined for each exposure scenario.

The following is a list of the three exposure scenarios for which unit exposures were determined from these studies and the PPE worn in the studies that would normally quantitatively affect the exposure:

- Mixing/loading emulsifiable concentrate formulation of methyl parathion using a closed system. PPE worn: double layer of clothes, gloves, and dust/mist respirator. 16 replicates.

- Mixing/loading microencapsulate formulation of methyl parathion using an open system. PPE worn: double layer of clothes, gloves, and dust/mist respirator. 26 replicates.

- Applying microencapsulate formulation of methyl parathion using an open cab groundboom. PPE worn: double layer of clothes, gloves, and dust/mist respirator. 15 replicates.

All five studies used to determine handler exposure to the above three scenarios are considered to be of sufficient scientific quality and meet most of the Series 875 Occupational and Residential Guidelines. See the study summaries above or the separate study reviews for more information. See Appendix Table A for an example of the conversion of the raw 4NP data into the unit exposure values used in this assessment. This example uses data from the study conducted on mixing/loading microencapsulate for aerial application (MRID # 45327101). See Table 3, shown below, for a comparison of the PHED unit exposure values and the unit exposure values determined from these studies. After the unit exposure values were obtained from the study data, the doses were calculated using the handler exposure equations listed previously in this assessment. See Appendix Table B for a complete list of all the individual calculated unit exposure values from the five studies.

Both inhalation and dermal exposure may result from the handling of methyl parathion. Biomonitoring data measures in total exposure (dermal + inhalation), therefore it is difficult to determine which route this exposure occurred from. Since the dermal and inhalation endpoints are very similar (0.11 mg/kg/day for inhalation and 0.1 mg/kg/day for dermal, see toxicology section for more information), there is no need to determine which route the exposure occurred from in this case. Only five inhalation replicates were taken in the five studies. The inhalation samples were taken in the mixer/loader study done on the microencapsulate formulation at the Arizona site (MRID # 45513001). The three detectable values were 0.0822, 0.195, and 0.125 µg/sample, with a LOQ of 0.05 µg/sample. The risks for these values were not assessed, since all routes of exposure to methyl parathion should result in the excretion of the metabolite, 4NP, in the urine of the workers, and therefore already takes inhalation exposures into account. The presence of detectable residues in three out of the five inhalation samples is significant, but more samples would need to be taken before it can be determined whether or not inhalation is a major route of exposure when handling methyl parathion in the microencapsulated form.

Table 3. Comparison of PHED and Study Unit Exposure Values.

	Mixer/Loader Microencapsulate Open System (mg/lb ai)	Mixer/Loader Emulsifiable Concentrate Closed System (mg/lb ai)	Open Groundboom Tractor Applicator Microencapsulate (mg/lb ai)
PHED unit exposure (dermal/inhalation)	0.017/ 0.00024 (liquid surrogate data)	0.0086/0.000083	0.011/0.00015 (liquid surrogate data)
PPE worn	double layer of clothes, gloves, dust/mist respirator	single layer of clothes, gloves	double layer of clothes, gloves, dust/mist respirator
# of PHED Replicates	75 to 122 dermal, 53 hand, 85 inhalation	16 to 22 dermal, 31 hand, 27 inhalation	23 to 42 dermal, 21 hand, 22 inhalation
Study Unit Exposure (total)	0.000201	0.000030	0.000468
PPE worn	double layer of clothing, gloves, plastic goggles, and dust/mist filtering respirator. Some workers also wore a face shield, instead of goggles, chemical resistant apron, and Tyvek® rain type hat.	Double layer of clothing, gloves, protective eye wear, chemical-resistant apron; and dust/mist filtering respirator.	double layer of clothes, gloves, protective eyewear, chemical-headgear; and dust/mist respirator
# of Study Replicates	26	16	15
Study Distribution/ Average Used	neither lognormal or normal/ median	neither lognormal or normal/ median	lognormal/ geometric mean
90th Percentile Study Unit Exposure Value (total)	0.000882	0.000151	0.00186

The following factors should be considered when comparing the differences in the unit exposure values calculated from the study and the PHED unit exposure values. The PHED data unit exposure values for mixing/loading of the microencapsulate formulation were conducted using liquids not a microencapsulate formulation, therefore, the study unit exposure values for this formulation should be considered more representative for the mixing/loading scenario than the PHED values. The lower microencapsulate unit exposure values may indicate that the microencapsulate formulation is not as readily absorbed into the skin as a liquid, since is in encased in the microcapsules. Also, the workers in the chemical specific studies were wearing more PPE than the workers did in the PHED studies. In the groundboom study, in addition to the double layer of clothing, gloves and dust/mist respirator, the workers wore plastic eyewear and headgear. In the mixer/loader studies, the some workers wore eyewear or face shields, rain hats and aprons, in addition to the double layer of clothing, gloves and dust/mist respirator. In the closed mixing/loading study for the emulsifiable concentrate formulation, the workers wore double layer of clothing and a dust/mist respirator, which are not normally worn by workers operating closed systems. This extra PPE may have lowered the study unit exposure values in comparison to the PHED data.

Short-term and intermediate-term exposures and doses at baseline are presented in Appendix Table E. The short- and intermediate term MOEs at the additional PPE level of mitigation are presented in Appendix Table F. The short- and intermediate term MOEs at the engineering controls level of mitigation are presented in Appendix Table G. Table 4 summarizes the MOEs calculated for each mitigation level. Appendix Table H summarizes the caveats and parameters specific to each exposure scenario and corresponding risk assessment The short and intermediate term MOEs are identical since they have the same endpoint.

Table 4. Summary of Occupational Short and Intermediate Term Total Inhalation and Dermal MOEs for Methyl Parathion.

Exposure Scenario (Scenario #)	Unit Exposure Data Source[a]	Maximum Application Rate (lb ai/acre)[b]	Crop[c]	Daily Acres Treated[d]	Total MOE[e]		
					Baseline[f]	Additional PPE[g]	Engineering Controls[h]
Mixer/Loader Exposure and Dose Levels							
Mixing/Loading Liquids (EC and ME formulations) for Aerial/Chemigation Application (1a)	PHED (liquid used as a surrogate for M/L the ME formulation)	0.375	sugar beets	350	0.018	3	6
		1.0	Alfalfa		0.0069	1	2
		2.0	Walnut		0.0034	0.58	1
		0.5	Corn	1200	0.0040	0.68	1
		1.0	Alfalfa		0.0020	0.34	1
Mixing/Loading Liquids (EC and ME formulation) for Groundboom Application (1b)		0.375	sugar beets	80	0.080	14	27
		1.5	Potato		0.020	3	7
		0.5	Corn	200	0.024	4	8
		1.0	Alfalfa		0.012	2	4
Mixing/Loading Liquids (ME formulation) for Airblast Sprayer (1c)		2.0	Walnut	40	0.030	5	10
Mixing/Loading Liquids (EC formulations) for Aerial Application (2a)	Study (45527601) median	0.375	sugar beets	350	ND	ND	1800
		1.5	Potato				440
		0.5	Corn	1200			390
		1.0	Alfalfa				190
Mixing/Loading Liquids (EC formulation) for Aerial Application (2b)	Study (45527601) 90th percentile	0.375	sugar beets	350	ND	ND	350
		1.5	potato				88
		0.5	Corn	1200			77
		1.0	Alfalfa				39
Mixing/Loading Liquids (EC formulations) for Groundboom Application (2c)	Study (45527601) median	0.375	sugar beets	80	ND	ND	7800
		1.5	potato				1900
		0.5	Corn	200			2300
		1.0	Alfalfa				1200
Mixing/Loading Liquids (EC formulation) for Groundboom Application (2d)	Study (45527601) 90th percentile	0.375	sugar beets	80	ND	ND	1500
		1.5	potato				390
		0.5	Corn	200			460

Table 4. Summary of Occupational Short and Intermediate Term Total Inhalation and Dermal MOEs for Methyl Parathion.

Exposure Scenario (Scenario #)	Unit Exposure Data Source[a]	Maximum Application Rate (lb ai/acre)[b]	Crop[c]	Daily Acres Treated[d]	Total MOE[e]		
					Baseline[f]	Additional PPE[g]	Engineering Controls[h]
		1.0	Alfalfa				230
Mixing/Loading Liquids (ME formulation) for Aerial/Chemigation Application (3a)	Study (45327101, 45513001) Median	0.5	Onion	350	ND	200	ND
		1.0	corn			100	
		2.0	Walnut			50	
		1	corn	1200		29	
Mixing/Loading Liquids (ME formulation) for Aerial/Chemigation Application (3b)	Study (45327101, 45513001) 90th percentile	0.5	Onion	350	ND	45	ND
		1.0	corn			23	
		2.0	Walnut			11	
		1	corn	1200		7	
Mixing/Loading Liquids (ME formulation) for Groundboom Application (3c)	Study (45327101, 45513001) Median	0.5	Onion	80	ND	870	ND
		1.5	Potato			290	
		1	corn	200		170	
Mixing/Loading Liquids (ME formulation) for Groundboom Application (3d)	Study (45327101, 45513001) 90th percentile	0.5	Onion	80	ND	200	ND
		1.5	Potato			66	
		1	corn	200		40	
Mixing/Loading Liquids (ME formulation) for Airblast Sprayer (3e)	Study (45327101, 45513001) Median	2	walnuts	40	ND	440	ND
Mixing/Loading Liquids (ME formulation) for Airblast Sprayer (3f)	Study (45327101, 45513001) 90th percentile	2	walnuts	40	ND	100	ND
Applicator Exposure							
Applying Liquids with Aerial Equipment (EC and ME formulations) (4)	PHED	0.375	sugar beets	350	See Eng. Controls	See Eng. Controls	11
		1.0	Alfalfa				4
		2.0	Walnut				2
		0.5	Corn	1200			2

Table 4. Summary of Occupational Short and Intermediate Term Total Inhalation and Dermal MOEs for Methyl Parathion.

Exposure Scenario (Scenario #)	Unit Exposure Data Source[a]	Maximum Application Rate (lb ai/acre)[b]	Crop[c]	Daily Acres Treated[d]	Total MOE[e]		
					Baseline[f]	Additional PPE[g]	Engineering Controls[h]
		1.0	Alfalfa				1
Applying Liquids with a Groundboom Sprayer (EC and ME formulations) (5)	PHED	0.375	sugar beets	80	16	21	46
		1.5	Potato		4	5	12
		0.5	Corn	200	5	6	14
		1.0	Alfalfa		2	3	7
Applying Liquids with a Groundboom Sprayer (ME formulation) (6a)	Study (45449001, 45502401) geometric mean	0.5	Onions	80	ND	370	ND
		1.5	Potato			130	
		1.0	Corn	200		75	
Applying Liquids with a Groundboom Sprayer (ME formulation) (6b)	Study (45449001, 45502401) 90th percentile	0.5	Onions	80	ND	94	ND
		1.5	Potato			31	
		1.0	Corn	200		19	
Applying Sprays with an Airblast Sprayer (ME formulation) (7)	PHED	2.0	Walnut	40	0.24	0.40	5
Flagger Exposure							
Flagging Aerial Spray Applications (EC and ME formulations) (8)	PHED	0.375	sugar beets	350	4.7	5	240
		1.0	Alfalfa		1.8	2	88
		2.0	Walnut		0.88	0.99	44

Footnotes

EC = emulsifiable concentrate formulation. ME = microencapsulate formulation.

ND = No data for this scenario for this data source.

a Unit exposure data source: PHED unit exposure data shown for all scenarios, either as the sole unit exposure data source or as a comparison to the unit exposure data determined from the studies. Unit exposure data from the studies shown for the average unit exposure value and the 90th percentile. See above study summaries and description of unit exposure calculations shown previously in this document for more information.

b Application rates are a range of maximum application rates proposed by the registrant and on the labels. See list of crop specific application rates in the use section of this assessment for more information.

c Crops named are index crops which are chosen to represent all other crops at or near that application rate for that use. See the application rates listing in the use summary section of this document for further information on application rates used in this assessment. **Note:** For scenarios that represent both formulations (scenarios 1, 4, 5, and 8), some index crops may not exist for a formulation or maybe have a different application rate for that formulation. The assessment of the range of application rates that exists for a scenario is what is assessed, index crops are only for clarification.

d Daily amount treated are based on Science Advisory Council for Exposure Policy # 9.1.[11]

e Total Short and Intermediate Term MOE =1/((1/dermal MOE)+(1/inhalation MOE)). See Appendix Tables E, F, and G for individual dermal and inhalation values.

f Baseline exposure represents long pants, long sleeved shirt, no gloves, no respirator, open mixing/loading, open cab tractor. Baseline data are not available for aerial equipment.

g Additional PPE represents long pants, long sleeved shirt, coveralls, gloves, dust/mist respirator, open mixing/loading, open cab tractor.

h Engineering controls represent long pants, long sleeved shirt, no gloves or respirator with the following equipment:

Scenario Number	**Engineering Controls**
1/3	Closed mixing / loading, single layer clothing, chemical resistant gloves.
2	Micromatic "DV" liquid transfer system, gloves, double layer clothing, and dust/mist respirator
4, 5, 6, 7	Enclosed cab, single layer clothing, no gloves.
8	Enclosed truck (98% Protection Factor), single layer clothing, no gloves.

Summary of Risk Concerns for Handlers, Data Gaps, and Confidence in Exposure and Risk Estimates

Dermal and inhalation risks for handlers were combined into a total MOE since the effects seen at the LOAEL were the same (cholinesterase inhibition). Handler exposures to methyl parathion are expected to be short and intermediate term (one day to a month, one month to several months). Since short and intermediate term exposures have the same endpoints, the following risks are for both durations of exposure. The target MOE for occupational exposures is 100 (3x assigned to the short and intermediate term dermal endpoint was already accounted for by dividing the LOAEL of 0.3 mg/kg/day by 3 to determine an adujusted LOAEL of 0.1 mg/kg/day for use in the risk calculations).

Handler Scenarios

Baseline Level of Mitigation

The calculations of short-and intermediate-term risk indicate that the total MOEs are **less than <u>100</u>** at **baseline** level of mitigation for all assessed scenarios.

Additional PPE Level of Mitigation

The calculations of short-and intermediate-term risk indicate that the total MOEs are **less than <u>100</u>** at **additional PPE** level of mitigation for all assessed scenarios **except** for the following scenarios:

(3a) Mixing/loading Liquids (ME formulation) for Aerial/Chemigation Application (study data, median) at an application rate of 2 lbs ai/acre and 350 acres per day and an application rate of 1 lb ai/acre and 1,200 acres per day.

(3c) Mixing/loading Liquids (ME formulation) for Groundboom Application (study data, median)

(3d) Mixing/loading Liquids (ME formulation) for Groundboom Application (study data, 90th percentile) at an application rate of 0.5 lbs ai/acre and 80 acres per day.

(3e) Mixing/loading Liquids (ME formulation) for Airblast Application (study data, median)

(3f) Mixing/loading Liquids (ME formulation) for Airblast Application (study data, 90th percentile)

(6a) Applying Liquids (ME formulation) with a Groundboom Sprayer (study data, geometric mean) at application rates 0.5 and 1.5 lb ai/acre and 80 acres per day.

Engineering Controls Level of Mitigation

The calculations of short-and intermediate-term risk indicate that the total MOEs are **less than <u>100</u>** at **engineering control** level of mitigation for all assessed scenarios **except** for the following scenarios:

(2a) Mixing/loading Liquids (EC formulation) for Aerial Application (study data, median).

(2b) Mixing/loading Liquids (EC formulation) for Aerial Application (study data, 90th percentile) at an application rate of 0.375 lb ai/acre and 350 acres per day.

(2c) Mixing/loading Liquids (EC formulation) for Groundboom Application (study data, median)

(2d) Mixing/loading Liquids (EC formulation) for Groundboom Application (study data, 90th percentile)

(8) Flagging Aerial Spray Applications (EC and ME formulations) (PHED data) at an application rate of 0.375 lb ai/acre and 350 acres per day.

Data Gaps

Chemical specific data do not presently exist for the following scenarios and may further refine exposure and risk calculations: applying the emulsifiable concentrate formulation with aerial equipment and groundboom equipment, applying the microencapulate formulation with aerial equipment and airblast sprayers, and flagging aerial spray operations for both formulations.

Data Quality and Confidence in the Assessment

All PHED data used in this assessment had either a high or medium confidence level. The PHED data used to assess mixing/loading of the microencapsulate formulation was conducted using liquids not a microencapsulate formulation, therefore, the study data conducted on this formulation should be considered more representative for the mixing/loading scenario than the PHED data. All five studies used to determine handler exposure are considered to be of sufficient scientific quality and meet most of the Series 875 Occupational and Residential Guidelines. All five studies used also had a sufficient number of replicates, ranging from 15 to 26 per scenario assessed.

Occupational Handler Summary

- For mixing/loading the emulsifiable concentrate formulation, all of the assessed scenarios have a risk of concern using PHED data. Using the chemical specific data, only one out of the four scenarios have a risk of concern at engineering controls, mixing/loading for aerial application using the 90th percentile study data.

- For mixing/loading the microencapsulate formulation, all of the assessed scenarios have a risk of concern using PHED data. Using the chemical specific data, three out of the four scenarios assessed have a risk of concern at the additional PPE level of exposure, mixing/loading for aerial/chemigation applications at the median and 90th percentile and mixing/loading for groundboom applications at the 90th percentile.

- For applying the emulsifiable concentrate formulation, no chemical specific data were available and all scenarios assessed using PHED surrogate data have a risk of concern.

- For applying the microencapsulate formulation, all of the assessed scenarios have a risk of concern using PHED data. Using the chemical specific data for applying microencapsulate with a groundboom, there is a risk of concern at an application rate of 1 lb ai/acre and 200 acres per day.

- For flagging aerial spray applications, no chemical specific data was available for either formulation. Using the PHED surrogate data, there is a risk of concern at an application rate of 1 and 2 lb ai/acre and 350 acres per day.

The risks from mixing/loading the microencapsulate formulation and applying the microencapsulate formulation by groundboom that were assessed using the study data are less than those assessed using the PHED surrogate data. This may indicate that the microencapsulate formulation is not as readily absorbed into the skin as a liquid, since is in encased in the microcapsules. Risks of concern still exist using the study data, especially at the 90th percentile. The PHED surrogate data does have more replicates (53 to 122) compared with the study data (26) for mixing/loading and 39 to 47 PHED replicates compared to 15 study replicates for applying sprays with a groundboom, but the study data does not contain any replicates using the microencapsulate formulation.

The risks from mixing/loading the emulsifiable concentrate formulation in the closed micromatic "DV" liquid transfer system are lower than those assessed using closed mixing/loading PHED liquid data. This may indicate that the closed system used in this study is effective at reducing the risks from mixing/loading the emulsifiable concentrations. Although, the study conducted on the closed mixing and loading using the micromatic "DV" transfer system had workers wearing more PPE than would normally be used with an engineering control, such as double layer of clothing and a dust/mist respirator. Risks of concern still exist using the study data at the higher usage amounts (1200 acres per day) and the 90th percentile. The PHED data does have more replicates (16 to 32) compared with the study data (16) for mixing/loading.

Occupational Postapplication Exposures and Risks

Current label REI and Early Entry PPE

The restricted-entry intervals on currently registered methyl parathion labels were set according to the requirements stated in the memorandum of agreement between the primary methyl parathion registrants and the Agency, dated August 2, 1999. The REIs set in the agreement were considered interim until methyl parathion DFR data were reviewed and analyzed in order to determine the final requirements for the REIs. These interim restricted-entry intervals are 4 days, except for areas receiving less than 25 inches of average rainfall per year. In these low rainfall areas the restricted-entry interval is 5 days.

The current label early entry PPE is as follows: coveralls over long sleeved shirt and long pants, waterproof gloves, chemical resistant footwear and socks, protective eye wear, and chemical resistant headgear for overhead exposure.

Chemical Specific Data

The Agency has determined that there are potential postapplication exposures to individuals entering treated fields. Chemical specific handler data were submitted by the Cheminova and Cerexagri according to the requirements stated in the memorandum of agreement between the primary methyl parathion registrants and the Agency, dated August 2, 1999. Cheminova submitted three dislodgeable foliar residue (DFR) studies on corn, cabbage and cotton in support of the emulsifiable concentrate formulation. Cerexagri submitted four DFR studies on corn, walnuts, and cotton and three postapplication biomonitoring studies on walnut harvesting, sweet corn hand harvesting, and cotton scouting, in support of the microencapsulate formulation. The postapplication microencapsulate studies were done concurrently with the DFR studies in order to determine the transferability of the microencapsulate for the activity conducted in the studies. These studies have been reviewed by the Agency for compliance with OPPTS Series 875: Occupational and Residential Exposure Test Guidelines. All workers who participated in the biomonitoring studies read and signed Informed Consent forms, which explained the purpose of the study, the procedures, and a statement of their rights. A brief summary of the study and any important issues follow. In depth reviews of each submitted study used in this assessment can be found in the individual Agency study reviews, as cited on the reference page at the end of this assessment. The level of DFR of methyl paraoxon, a degradate of methyl parathion, was also determined in the DFR studies. No toxicity data exist for methyl paraoxon, so it is assumed to have the same toxicity as methyl parathion. Therefore, the DFR values for methyl paraoxon were combined with the methyl parathion DFR values found on that day.

Emulsifiable Concentrate DFR studies

Cabbage DFR study

"Dissipation of the Dislodgeable Foliar Residues of Methyl Parathion and Methyl Paraoxon After Application of Methyl Parathion 4EC® Insecticide to Cabbage." (MRID No. 453174-01)[13]

Methyl parathion was applied to cabbage in three geographical locations: Georgia, Louisiana, and California. Methyl parathion 4EC®, an emulsifiable concentrate, was applied at all locations. This study was conducted to determine the residue levels of methyl parathion and its oxygen analog, methyl paraoxon, that can be dislodged from cabbage following two applications of the test substance, each at the maximum application rate of 1.5 pounds ai per acre. Applications were made using ground equipment typical for broadcast applications to cabbage.

Cabbage leaf punch samples were collected from treated and untreated control plots in Hawkinsville, Georgia, Lecompte, Louisiana, and Madera, California. A second repeat trial was conducted in Louisiana to compare results. The study author believes the results of the second Louisiana trial better represent the normal rate of dissipation of methyl parathion residues on cabbage, since the temperatures during the first Louisiana trial were well below normal and the temperatures during the second trial were near normal temperatures. However, Trial 1 was conducted during winter months (December through February), whereas, Trial 2 was conducted during the summer months (August and September). According to USDA, most commercial cabbage in the South and in California is planted in the fall and winter for winter and spring harvest, therefore, Trial 1 is more representative of the actual use of methyl parathion on cabbage. DFR samples from two separate plots were also taken during the second Louisiana trial to determine if the application volume had an effect on the dissipation of the residues. The overall average field recovery results from all sites and for both methyl parathion and methyl paraoxon were greater than 90 percent, therefore none of the DFR data from this study were corrected for field recovery.

The study was in compliance with the major technical aspects of the OPPTS Series 875 guidelines. The most important issues of concern are identified below:

- Applications of the test substance were not made at the least dilution. For ground applications, the label recommends a minimum of 3 gallons of water per acre. In this study, approximately 10 to 30 gallons of water per acre were used.

- Rainfall occurred on the day of the second application, the day after application and 7, 21, and 28 days after the second application in Georgia. During Trial 2 in Louisiana, rainfall occurred 2, 3, 10, and 14 days after the second application.

Corn DFR study

"Dissipation of the Dislodgeable Foliar Residues of Methyl Parathion and Methyl Paraoxon After Application of Methyl Parathion 4EC® Insecticide to Sweet Corn." (MRID No. 452837-01)[14]

Methyl parathion was applied to sweet corn in three geographical locations. Methyl parathion 4EC®, an emulsifiable concentrate, was applied at all locations. This study was conducted to determine the residue levels of methyl parathion and its oxygen analog, methyl paraoxon, that can be dislodged from sweet corn foliage following two applications of the test substance, each at the maximum application rate of 0.5 pounds ai per acre. (A third application was necessary at the California site due to a heavy rain that occurred within a few hours after the second application.) Applications were made using ground equipment typical for broadcast applications to sweet corn.

Sweet corn leaf punch samples were collected from treated and control plots in Winter Garden, Florida, Cheneyville, Louisiana, and Madera, California. Sampling was performed immediately prior to and after each application, and 1, 3, 4, 5, 7, 10, 14, 21, 28, and 35 days after the last treatment (treatment 2 in Florida and Louisiana; treatment 3 in California). The overall average field recovery results from all sites and for both methyl parathion and methyl paraoxon were greater than 90 percent, except for methyl parathion field recovery value at the California site (86%) and the methyl paraoxon value at the Louisana site (87.6%). Therefore only these two DFR data sets from this study were corrected for field recovery.

The study was in compliance with the major technical aspects of the OPPTS Series 875 guidelines. The most important issues of concern are identified below:

- The guidelines specify that the application rate should be at the highest label rate and the least dilution. Applications of the test substance were not made at the least dilution. For ground applications, the label recommends a minimum of 3 gallons of water per acre. In this study, approximately 10 to 20 gallons of water per acre were used.

- The study results showed extremely rapid residue dissipation, with the no detectable residues the day after application at the California and Florida sites and no detectable residues on the third day after application at the Louisiana site.

Cotton DFR study

"*Dissipation of Dislodgeable Foliar Methyl Parathion and Methyl Paraoxon After Application of Methyl Parathion 4EC Insecticide to Cotton*" (MRID No. 452925-01)[15]

Methyl parathion was applied to cotton plants in three geographical locations: California, Louisiana, and Texas. Cotton plants were treated with Cheminova Methyl Parathion 4EC® emulsifiable concentrate, at all sites. The study was conducted to determine the residue levels of methyl parathion and a metabolite/degradation product, methyl paraoxon, that could be dislodged from cotton foliage following five ground spray applications of the test substance, each at an application rate of 1.5 pounds ai per acre. The sampling was performed the day prior to and immediately following application for each of the five applications, and on Days 0, 1, 2, 3, 5, 7, 10, 14, 21, 28, and 35 days after the fifth application. The overall average field recovery results from all sites and for both methyl parathion and methyl paraoxon were greater than 90 percent, therefore none of the DFR data from this study were corrected for field recovery.

The study was in compliance with most of the major technical aspects of OPPTS Series 875 guidelines. Issues of concern are identified below:

- The guidelines specify that the application rate should be at the highest label rate and the least dilution. The product was not applied at the maximum rate. The label states that the maximum application rate for cotton is 6 pints of formulated product per acre or 3.0 pound ai per acre. In this study, cotton grown in California, Louisiana, and Texas were sprayed five times at the rate of 3 pints per acre or 1.5 pounds ai per acre. Applications were made using 10-20 gallons per acre. However, the registrant has agreed to lower the emulsifiable concentrate application rate for cotton to 0.75 lb ai/acre.

Microencapsulate DFR studies

Corn DFR study

"*Postapplication Exposure Monitoring: Foliar Dislodgeable Residue Dissipation of PENNCAP-M® in Sweet Corn (EPA Region I).*" MRID No. 452750-01[16]

Methyl parathion was applied to sweet corn in one geographical location in Lyons, New York (a companion sweet corn study was conducted at a earlier date in California and Florida MRID # 452697-01). The insecticide was applied as PENNCAP-M® microcapsules containing 20.9 percent methyl parathion. This study was conducted to determine the residue levels of methyl parathion and one metabolite/degradation product, methyl paraoxon, that can be dislodged from sweet corn foliage following four ground spray applications of the test substance at a rate of 0.75 pounds ai per acre per application. The DFR data were corrected for the following field recoveries: for methyl parathion, 95% and for methyl paraoxon, 88%. Even though DFR data are usually corrected for field recovery values that are less than 90 percent, since the study author had previously corrected the DFR data and the field recoveries are less than 100 percent, HED will use the corrected DFR data.

The study was in compliance with the major technical aspects of OPPTS Series 875 guidelines. The most important issues of concern are identified below:

- The product was not applied at the current maximum rate. The label states that the maximum application rate for sweet corn is 4 pints of formulated product per acre (1.0 pound ai per acre). In this study, sweet corn grown in New York were sprayed four times at the rate of 3 pints per acre (0.75 pounds ai per acre). However, the registrant has agreed to lower the microencapsulate application rate for sweet corn to 0.75 lb ai/acre.

"Foliar Dislodgeable Residue Dissipation of PENNCAP-M® in Sweet Corn." (MRID No. 452697-01)[17]

Methyl parathion was applied to sweet corn in two geographical locations: Florida and California. A companion sweet corn study was conducted at a later date in New York State (MRID# 45275001). This report also includes a review of the amended final study report which was submitted approximately four months after the original study report (MRID# 45288901). Results from the Florida site, as presented in the original study report, showed rapid dissipation of dislodgeable methyl parathion residues. The amended report provides data generated from the reanalysis of specific samples from the Florida site at a lower limit of quantitation (LOQ), as well as results from an additional storage stability interval to support it. PENNCAP-M® microencapsulate was applied at both locations. This study was conducted to determine the residue levels of methyl parathion and two metabolites/degradation products, methyl paraoxon and 4-nitrophenol, that can be dislodged from sweet corn foliage following four applications of the test substance, each at an application rate of 0.75 pounds ai per acre. Applications were made using ground spray equipment at the California site and aerial spray equipment at the Florida site. The overall average field recovery results from all sites and for both methyl parathion and methyl paraoxon were between 90 and 100 percent. Even though DFR data are usually corrected for field recovery values that are less than 90 percent, since the study author had previously corrected the DFR data and the field recoveries are less than 100 percent, HED will use the corrected DFR data. The DFR data were corrected for the following field recoveries: for methyl parathion, 96.6% at the Florida site and 97.5% at the California site; for methyl paraoxon, 98.8% at the Florida site and 89.5% at the California site.

The study was in compliance with the major technical aspects of OPPTS Series 875 guidelines. The most important issues of concern are identified below:

- The product was not applied at the maximum rate. The label states that the maximum application rate for sweet corn is 4 pints of formulated product per acre (1.0 pound ai per acre). In this study, sweet corn grown in Florida and California were sprayed four times at the rate of 3 pints per acre or 0.75 pounds ai per acre. However, the registrant has agreed to lower the microencapsulate application rate for sweet corn to 0.75 lb ai/acre.

Cotton DFR study

"*Dissipation of Dislodgeable Foliar Methyl Parathion Residues Following Application of PENNCAP-M® Microencapsulated Insecticide to Cotton.*" (MRID No. 452697-02)[18]

Methyl parathion was applied to cotton plants in three geographical locations: California, Louisiana, and Texas. Cotton plants were treated with PENNCAP-M® Microencapsulated Insecticide. The study was conducted to determine the residue levels of methyl parathion and two metabolites/degradation products, methyl paraoxon and 4-nitrophenol, that could be dislodged from cotton foliage following four ground spray applications of the test substance, each at an application rate of 1.0 pounds ai per acre. The study was in compliance with the major technical aspects of OPPTS Series 875 guidelines. The DFR data were corrected for the following average field recoveries: for methyl parathion, 99 percent at the Texas site and for methyl paraoxon, 91 percent and 93 percent at the California and Texas sites, respectively. Even though DFR data are usually corrected for field recovery values that are less than 90 percent, since the study author had previously corrected the DFR data, HED will use the corrected DFR data for all field recovery data less than 100 percent. The study was in compliance with the major technical aspects of OPPTS Series 875 guidelines.

Walnut DFR study

"*Foliar and Soil Dislodgeable Residue Dissipation of Methyl Parathion Residues Following Applications of Penncap-M® Microencapsulated Insecticide on Walnuts.*" (MRID # 453592-01 and 454009-01 amended)[19]

Methyl parathion was applied to walnuts in three geographical locations in southern California. The study was conducted in California only, because Penncap-M® has a Section 24(c), Special Local Needs label and is used to control codling moth, navel orange worm, San Jose scale, and walnut scale and almost 100 percent of commercial walnuts are grown in California. Penncap-M® microencapsulate was applied at all locations. This study was conducted to determine the residue levels of methyl parathion and its oxygen analog, methyl paraoxon, that can be dislodged from walnut foliage and soil following four applications of the test substance, each at the maximum application rate of 2 pounds ai per acre. All applications were made using airblast application equipment. The DFR data were corrected for the following average field recoveries: for methyl paraoxon, 66% at the Ripon site. The soil residue data were corrected for the following average field recoveries: for methyl parathion, 96 % at the Fresno site, 95% at the Porterville site, and 83 % at the Ripon site and for methyl paraoxon, 79 % at the Fresno site, 79 % at the Ripon site, and 64 at the Porterville site. Even though DFR data are usually corrected for field recovery values that are less than 90 percent, since the study author had previously corrected the DFR data, HED will use the corrected DFR data for all field recovery data less than 100 percent.

The study was in compliance with the major technical aspects of the OPPTS Series 875 guidelines. The most important issues of concern are identified below.

- The overall field fortification recovery for DFR samples of methyl paraoxon from Ripon (66 ± 48 percent) showed a high degree of scatter. The study author stated that the reason for the scatter is unknown, however, it is possible that field fortification techniques may have been a contributing factor, as indicated in the field raw data for this site.

- Rainfall occurred on 2nd and 14th day after the fourth application in Ripon, and on 7th and 10th day after the fourth application in Porterville.

- At the Ripon test site, leaf punch samples could not be collected after the 21st day after the fourth application because of premature leaf loss.

Microencapsulate Postapplication Biomonitoring Studies

Sweet Corn Hand Harvesting Biomonitoring Study

"*Biomonitoring Assessment of Worker Exposure to Methyl Parathion During Sweet Corn Hand-Harvesting Following Application of PENNCAP-M® Microencapsulated Insecticide.*" (MRID No. 452001-01).[20]

The purpose of this study was to quantify potential worker exposure due to hand-harvesting of sweet corn following four treatments of the crop with methyl parathion. PENNCAP-M® Microencapsulated Insecticide was applied at 0.75 lbs ai/acre. The insecticide was applied at 5 gallons/acre. The minimum application volume referenced on the product label is 2 gallons/acre.

Four days after the last PENNCAP-M® application, sixteen subjects harvested sweet corn from a 13 acre test plot during a single work period, which lasted about 5.6 hours (in-field). The test plot was located near Stuart, FL (Martin County). While hand harvesting sweet corn, study subjects wore identical, new clothing. This consisted of: long-sleeved shirts, undershirt, long pants, socks and underwear. All subjects wore closed shoes, some subjects wore hats, but none wore protective gloves. Twenty-four hour urine samples were collected from each worker beginning 2 days prior to hand-harvesting, and for 2 days after hand-harvesting. The workers were housed in a hotel during this period, leaving it only to perform hand-harvesting on the day of exposure and to eat meals. A total of 306 urine samples were analyzed for metabolites of methyl parathion, 4-nitrophenol and its sulfate and glucuronide conjugates. The 90 field samples were also analyzed for creatinine content. The raw data for the Florida site were corrected for a field recovery value of 84.6%. In this study, the study authors corrected the field recovery values for laboratory recoveries. However, the raw data were not corrected for laboratory recovery values, therefore the field recovery values used in this assessment were left uncorrected for laboratory recovery values by HED. The uncorrected field recovery values take into account residue losses from the field, transport, storage, and analytical method, since the field recovery samples travel with and are analyzed with the field samples.

The study followed the OPPTS Series 875 Occupational and Residential Exposure Test Guidelines, Group B: Postapplication Exposure Monitoring Test Guidelines 875.2600, and Part C & D in most respects. The following issues of potential concern were identified:

- The spray application was not done at the highest label rate and lowest label dilution as required in the guidelines. Methyl parathion was applied four times at a single rate of 0.75 lbs ai/A to the test site. The maximum label rate was 1.0 lbs. ai/A. The application volume was 5 gallons/acre, and the label recommended minimum was 2 gallons/acre. However, the registrant has agreed to lower the microencapsulate application rate for sweet corn to 0.75 lb ai/acre.

- EPA' s guidelines require "*a minimum of 15 replicates per activity and preferably 5 replicates (i.e. individuals) for each of three monitoring periods... in three geographical locations*." There was only one monitoring period. Also, the study was conducted at a single location, instead of the preferred 3 locations. Two other sites were tested for DFR residues on sweet corn, one in New York and one in California. Considering that Florida has the warmest and wettest climate of the three possible locations, it is not the worst-case location for residue dissipation. The other two sites tested had at least 100 times more residue on the day of the activity (day 4 or 5) than the Florida site. The dislodgeable residues found on the fourth day after the final application at the Florida site were extremely low at 3.6 nanograms/cm^2. However, 16 individuals were monitored at that site.

- Creatinine levels were very low on the day of exposure in three workers, relative to the other workers.

Cotton Scouting Biomonitoring Study

"*Biomonitoring Assessment of Worker Exposure to Methyl Parathion during Cotton Scouting Following Applications of Penncap-M Microencapsulated Insecticide.*" (MRID No. 452047-01)[21]

Methyl parathion was applied to cotton plants in three geographical locations: California, Louisiana, and Texas. Cotton plants were treated with PENNCAP-M® Microencapsulated Insecticide. The study was conducted to quantify potential worker exposure due to scouting cotton treated with methyl parathion. The cotton was treated with four ground spray applications of methyl parathion, each at an application rate of 1.0 pounds ai per acre.

Volunteer study subjects performed a single day of cotton scouting either four days (Texas and Louisiana) or five days (California) after the last PENNCAP-M® application, when the cotton plants were 8 to 14 inches tall. There was approximately 4.5 hours of in-field exposure time, interrupted by 5 break-times, during which study subjects washed their hands. The study subjects spent about 8 hours in their work clothing. The study subjects wore identical, new clothing provided by the study coordinator. Work clothing consisted of: long-sleeved shirts, undershirt, long pants, underwear, socks, and hat. All subjects wore closed shoes. Gloves were not worn by the study subjects. In this study, methyl parathion exposure was quantified by measuring total 4-nitrophenol (4-NP) and its sulfate and glucuronide conjugates in urine samples (the analytical method hydrolyzes these conjugates to 4-nitrophenol equivalents). Twenty-four hour urine samples were collected for two days prior through 3 days after exposure, or 6 days total. The raw data were corrected for the following field recovery values: 67.2% for the Texas site, 69.1% for the Louisana site, 66.1% for the California site. These values are uncorrected for laboratory recoveries, since the raw data was not corrected for laboratory recovery.

The study was in compliance with the major technical aspects of OPPTS Series 875 guidelines, except for the following issue:

- Creatinine levels seem to have been unusually low, relative to the other workers, on the days after exposure in two California workers and one Texas worker.

Walnut Harvesting Biomonitoring Study

"*Biomonitoring Assessment of Worker Exposure to Methyl Parathion During Walnut Harvesting Following Applications of Penncap-M® Microencapsulated Insecticide*"(MRID # 453677-01 and 453915-01 amended)[22]

Methyl parathion was applied to walnut trees in California. Walnut trees were treated with PENNCAP-M® Microencapsulated Insecticide. Biological monitoring was used to measure exposure levels of walnut harvesters to methyl parathion after a seasonal regime of Penncap-M®. All four applications were made with an airblast sprayer at 21-day intervals. The insecticide was applied at 100 to 200 gallons per acre spray volume. The minimum application volume referenced on the product label is 10 gallons/acre.

The study was conducted at two sites in southern California (Fresno and Porterville). Fourteen (Fresno) or fifteen days (Porterville) after the last Penncap-M® application, fifteen subjects harvested walnuts during a single work period, which lasted about 8 hours (in-field), including breaks. Two activities were preformed at the sites, raking the walnuts on the ground and shaking the walnut trees. Workers 1 and 14 performed only the shaking task and workers 2 and 15 performed both the raking and shaking tasks. All other replicates performed only the raking task. Twenty-four hour urine samples were collected from each worker beginning 2 days prior to harvesting, and for 4 days after harvesting. The workers were housed in a hotel during this period, leaving only to perform hand-harvesting on the day of exposure and to eat meals. The study subjects wore identical, new standardized clothing while harvesting walnuts. The clothing consisted of: long-sleeved shirt and long pants over their choice of undergarments. All subjects wore socks and shoes. No other protective clothing was worn at the Fresno site. At the Porterville site, two replicates (Replicates 9 and 13) wore jackets at the start of the reentry event, but removed them during the early portion of the activity. Four replicates (Replicates 9, 10, 14, and 15) wore hats at the start of the reentry, but the hats were also removed during the course of the activity. Methyl parathion exposure was quantified by measuring 4-nitrophenol and its sulfate and glucuronide conjugates in urine samples (the analytical method used converts these two biological conjugates to 4-nitrophenol). Creatinine levels were measured in the urine samples as a qualitative check on the urine output of the monitored subjects. The raw data were corrected for the following field recovery values: 86% for the Fresno site and 73.4% for the Portersville site. These values are uncorrected for laboratory recoveries since the raw data was not corrected for laboratory recovery.

The study followed the OPPTS Series 875 Occupational and Residential Exposure Test Guidelines in most respects. The following issues of potential concern were identified:

- Inhalation monitoring was done using OVS air monitoring tubes affixed to portable stands at the height representative of the breathing zone of the rakers, stationed in the work space. Personal air samplers measure possible inhalation exposure more accurately, since the intake area is closer to the workers actual breathing zone. Work may not have been performed near the stationary sampling pumps during the entire course of the sampling period.

- Only five inhalation monitoring replicates were monitored at each of the two sites. EPA's guidelines states that *"Each study should include a minimum of 15 individuals (replicates) per activity."*

- Creatinine levels, after the exposure event, were unusually low for two workers at the Portersville site and unusually high for one worker at the Fresno site, relative to the other workers.

Exposure and Risk Calculations

Chemical specific DFR data exist for the emulsifiable concentrate formulation on cotton, corn and cabbage. Chemical specific DFR data exist for the microencapsulate formulation on cotton, corn and walnuts. The DFR data were extrapolated to all remaining crops. DFR data were taken at three sites for each crop tested for both formulations. Regression analyses were run on each data set, to determine half lives, correlation coefficients (R value), and in order to predict residues between sampling days or after the study was completed, if necessary. For each formulation, there was no apparent trend in the half lives of the DFR values between sites for a single crop, such as half lives being longer in arid regions. Therefore, for brevity, HED has chosen one site per crop per formulation to use in the calculation of Restricted entry Intervals (REIs). To be protective, the site with the longest half life was chosen. See Table 5 for a summary of the half lives and correlation coefficients determined for each study. The study chosen for that crop is in bold. The half lives of the microencapsulate formulation are longer than the emulsifiable concentrate formulation. This most likely occurred because the polymeric-type microcapsules are designed to slowly release the active ingredient over time. The crops were grouped in the tables according to similar application rates, transfer coefficients, and DFR data used.

Table 5. Comparison of Half lives of Methyl Parathion DFR values.

Crop	**Site**	**Half Life (days)**	**R value**	**Last Day Detectable Residues are Found**	**Total Amount of Rain that occurred after the last application in inches (day after application of first rain event)**
			EC formulation		
Cabbage	Georgia	0.82	0.91	5	4.28 (day 7)
	Louisiana (site 1)	**1.12**	**0.99**	**10**	none
	Louisiana (site 2)	NA	NA	1	1.0 (day 2)
	California	0.53	0.96	3	0.68 (day 21)
Corn	**Louisiana**	**0.44**	**0.94**	**2**	3.72 (day 9)
	California	NA	NA	0	none
	Florida	NA	NA	0	0.9 (day 10)
Cotton (bi-phasic analysis)	California (0-2 days)	0.30	0.98	NA	none
	California (2-14 days)	3.76	0.97	10	
	Louisiana (0-2 days)	0.28	0.92	NA	8.98 (day 7)
	Louisiana (2-14 days)	3.98	0.93	7	
	Texas (0-3 days)	**0.28**	**0.99**	**NA**	2.15 (day 19)

	Texas (3-28 days)	**12.1**	**0.85**	**21**	

Crop	Site	Half Life (days)	R value	Last Day Detectable Residues are Found	Total Amount of Rain that occurred after the last application in inches (day after application of first rain event)
ME formulation					
Corn	New York (plot 2)	1.1	0.98	10	2.62 (day 5)
	New York (plot 3)	3.5	0.91	35 (last day sampled)	
	Florida	0.4	0.97	7	1.18 (day 2)
	California	**4.8**	**0.96**	**28**	none
Cotton	**California**	**1.6**	**0.99**	**10**	none
	Louisiana	0.72	0.96	4	5.28 (day 8)
	Texas	0.76	0.99	4	6.66 (day 5)
Walnuts (Foliage)	**Fresno, CA**	**7.78**	**0.89**	**42 (last day sampled)**	1.6 (day 6)
	Ripon, CA	5.41	0.89	21	0.44 (day 3)
	Porterville, CA	6.46	0.92	40 (last day sampled)	0.76 (day 7)
Walnuts (Soil)	Fresno, CA	5.33	0.93	35 (last day sampled)	1.6 (day 6)
	Ripon, CA	**8.27**	**0.89**	**35 (last day sampled)**	0.44 (day 3)
	Porterville, CA	4.31	0.92	35 (last day sampled)	0.76 (day 7)

The DFR data was adjusted for other application rates using the following equation:

$$\text{Adjusted DFR } (\mu g/cm^2) = \frac{\text{Study DFR } (\mu g/cm^2) \times \text{crop application rate (lbs ai/A)}}{\text{study application rate (lbs ai/A)}}$$

Short/intermediate-term doses and MOEs were calculated as follows:

$$ADD = [DFR \times Tc \times ET \times mg/1000\ \mu g] \div BW$$

where:

ADD = average daily dose (mg/kg/day);
DFR = dislodgeable foliar residue ($\mu g/cm^2$);
Tc = transfer coefficient (cm^2/hr);
ET = exposure time (8 hours/day); and
BW = body weight (70 kg).

and

$$MOE = adjusted\ LOAEL\ /ADD$$

The assumptions used for both short and intermediate term postapplication exposures are as follows:

Assumptions

- The non-chemical specific transfer coefficients used in this assessment are from the Agricultural Reentry Task Force (ARTF) database. An interim transfer coefficient policy was developed by HED's Science Advisory Council for Exposure using the ARTF database (policy # 3.1). It is the intention of HED's Science Advisory Council for Exposure that this policy will be periodically updated to incorporate additional information about agricultural practices in crops and new data on transfer coefficients. Much of this information will originate from exposure studies currently being conducted by the ARTF, from the further analysis of studies already submitted to the Agency, and from the studies in the published scientific literature.[23] The maximum transfer coefficients for each crop were used to determine the highest possible postapplication exposure and restricted entry intervals. Scouting and irrigation transfer coefficients were also used to determine possible exemptions to the restricted entry intervals calculated for the highest postapplication exposures.

- Exposure time is assumed to be 8 hours per day. This represents a typical work day.

- The average body weight of 70 kg is used.

Chemical Specific Postapplication Worker Data Analysis

Transfer coefficients were calculated by HED from the three chemical specific postapplication biomonitoring studies and four microencapsulate DFR studies previously mentioned. The amount of methyl parathion that a worker was exposed to was determined by the amount of the methyl parathion metabolite, four (or para) nitrophenol (4NP) found in the workers' urine. The raw data (which consisted of the amount of 4NP found in a 24 hour urine sample) were corrected for four parameters: 1) field recovery data, 2) creatinine content, 3) molecular weight, and 4) metabolism of methyl parathion to 4NP in the body. The corrections for these parameters are explained under the above section entitled "Chemical Specific Handler Data Analysis" on page 19.

Method to Determine Microencapsulate Transfer Coefficient Values

Twenty four hour urine samples were taken for each worker two weeks before the study began (prescreen), two and one day before the exposure event, the day of exposure, and either two or three days after exposure. In order to determined worker exposures and risks resulting from the study data, the raw 4NP values found in each 24 hour urine sample must be converted into the amount of methyl parathion that each worker was exposed to using the four parameters discussed above. Then, these individual exposure values must be averaged into a single exposure value for each site where worker monitoring took place. The 4NP raw data were corrected and averaged according to the following steps:

1) The raw daily 4NP values were corrected for field recovery, if the field recovery for that site was below 90%.

2) The data were then corrected for creatinine values by first dividing each daily 4NP value by that day's creatinine value.

3) An average creatinine value for each worker was then determined by averaging that worker's daily creatinine values for the duration of the study.

4) Each daily 4NP value divided by that day's creatinine value, as determined in step 2, was then multiplied by the average creatinine value of that worker, as determined in step 3. This results in a total µg 4NP value for that day normalized for creatinine content.

5) The baseline level of 4NP in the workers is the amount of 4NP the was present in the worker's urine before the exposure event. This baseline level was determined by averaging the 4NP levels from the two days prior to exposure.

6) After the baseline 4NP level was determined for each worker, it was subtracted out of the daily 4NP amounts from the day of exposure and for each day after exposure. This was done to obtain the amount of 4NP that result only from the methyl parathion exposure in the study. If the baseline 4NP level was greater than the 4NP level found on that day, that day's 4NP level was recorded as a zero.

7) The 4NP levels from the day of exposure and each day after the exposure event, from step 6, were added together to determine a total 4NP value that resulted from the exposure event.

8) This total 4NP value was then corrected for molecular weight by multiplying by 1.89 mass unit methyl parathion/mass unit 4NP, as explained in the previous section.

9) Then the total 4NP value was corrected for the metabolism of methyl parathion into 4NP in the body by multiplying by (100 4NP/72 methyl parathion) = 1.39. (72% of methyl parathion is excreted to 4NP). This results in a total methyl parathion exposure in µg per worker.

10) The total methyl parathion exposure is then divided by the amount time the worker spent in the field in hours. The result was a µg ai/hour exposure value for each worker.

11) The statistical distribution of this data was then determined using the *W* test, developed by Shapiro and Wilk. If the data were determined to be lognormally distributed, then the geometric mean was used. If the data were determined to be normally distributed, then the arithmetic mean was used and if the data were neither log normally or normally distributed, then the median was used.

12) The 90^{th} percentile of the data distribution was also determined for each exposure scenario.

Transfer coefficients for the microencapsulate formulation were determined for sweet corn harvesting, cotton scouting and walnut harvesting. The activity of corn harvesting consisted of walking through the field and breaking off the whole ear (unshucked) and tossing it into the collection bin on the packing train as it moved through the field. The activity of walnut harvesting consisted of mechanical shaking of trees to dislodge nuts, hand-raking nuts from around the tree trunks and off berms, and mechanically blowing and sweeping nuts into windrows. The cotton scouting transfer coefficient was also used to determine exposures to the microencapsulate formulation from scouting on all applicable crops. The transfer coefficient for walnut harvesting was also used to determine exposures to the microencapsulate formulation from almond and pecan harvesting. ARTF transfer coefficients will be used for all microencapsulate postapplication scenarios that do not have specific transfer coefficients determined from these studies.

Transfer coefficients were determined by the dividing the average exposure per hour (µg/hour) as determined in steps 11 and 12 above for each site by the residue level found (µg/cm^2) at the site of the exposure on the day the exposure occurred. This results in a transfer coefficient value (cm^2/hour) per site. If the postapplication workers were monitored at more than one site for the same activity, the transfer coefficients from each site were averaged together. The transfer coefficients calculated using the average of the study data will be used in this assessment. The clothing worn in the studies consisted of: long sleeved shirts, long pants, undershirt, underwear, socks, and shoes. Some workers also wore hats. See Table 6 for a summary of the transfer coefficients calculated from these studies and see Appendix Table C for a list of each worker's exposure value per hour.

In the walnut studies, dislodgeable foliar residue and soil residue measurements were taken concurrently with the worker postapplication biomonitoring studies. The workers went in on the 14^{th} or 15^{th} day after application to either shake the walnut trees or hand rake the walnuts off of the ground. These activities often create dusty conditions, that the workers are then exposed to. Since biomonitoring data only measure total exposure, it is not possible to determine the level of exposure to the treated foliage and to the soil below. Therefore, HED has calculated a transfer coefficient for both soil and foliage, assuming all the exposures occurred for the soil or from the foliage. This was done by dividing the exposure by both the DFR value and soil residue values found on the day of entry. The soil transfer coefficient units are therefore µg/g dry soil. These transfer coefficients were then compared with the corresponding daily DFR and soil residue values to determine an REI. Both the walnut soil and foliage transfer coefficients and REIs are listed in the tables below.

Both inhalation and dermal exposure may result from the handling of methyl parathion. Biomonitoring data measures in total exposure (dermal + inhalation), therefore it is difficult to determine which route this exposure occurred from. Since the dermal and inhalation endpoints are very similar (0.11 mg/kg/day for inhalation and 0.1 mg/kg/day for dermal, see toxicology section for more information), there is no need to determine which route the exposure occurred from in this case. Only ten inhalation replicates were taken in the three postapplication worker studies. The inhalation samples were taken in the walnut harvesting study done on the microencapsulate formulation at both sites (MRID # 453677-01). Three air sampling pumps were affixed to portable stands at a height representative of the breathing zone of the rakers, and one sampling pump was place in each equipment cab of the shaker and the sweeper at both sites. All values were non detected, with a LOD of 0.05 µg/sample. Personal air samplers measure possible inhalation exposure more accurately than stationary air pumps, since the air intake area is closer to the workers' actual breathing zone. Work may not be performed near the stationary sampling pumps during the entire course of the sampling period. Therefore, the presence of no detectable inhalation residues in the samples may not indicate that there is no inhalation exposure as a result of walnut harvesting. The risks for these values were not assessed, since all exposures to methyl parathion should result in the excretion of the metabolite, 4NP, in the urine of the workers, and therefore already takes inhalation exposures into account.

Table 6. Comparison of Calculated Microencapsulate vs Policy Transfer Coefficients.

	sweet corn hand harvesting	**cotton scouting**	**walnut harvesting (shaking/hand raking/mechanical blowing)**	
Average	12,000 (cm^2/hour)	640 (cm^2/hour)	49 (cm^2/hour)	3 (g dry soil/hr)
90^{th} percentile	19,000 (cm^2/hour)	1,200 (cm^2/hour)	92 (cm^2/hour)	7 (g dry soil/hr)
Agriculture Transfer Coefficient Policy 3.1	17,000 (cm^2/hour)	1,500 (cm^2/hour)	NA	NA

Worker Exposure From Postapplication Studies

In addition to the transfer coefficients, the risk resulting from the worker's exposure from entering the treated fields in the three biomonitoring postapplication microencapsulate studies was also calculated. This was done using the same procedure as listed above in steps 1 through 9, except that the exposures were not divided by hours worked. Instead, the statistical distribution of the exposure data (µg/day) was determined using the *W* test, developed by Shapiro and Wilk. If the data were determined to be lognormally distributed, then the geometric mean was used. If the data were determined to be normally distributed, then the arithmetic mean was used and if the data were neither log normally or normally distributed, then the median was used. The 90^{th} percentile was also calculated. Then, the average of the data was converted into milligrams and divided by the average body weight of the study participants in kilograms, which results in an average dose (mg/kg/day). The risks were calculated by dividing the adjusted LOAEL (mg/kg/day) by the average dose (mg/kg/day). The workers were in the field for 5.6 hours for corn harvesting, 4.5 hours for cotton scouting, and 6 hours for walnut harvesting. The exposure data were also extrapolated to an 8 hour day and the risks resulting from those exposures were also calculated. See Table 7 for the results. See Appendix Table D for individual worker exposure values (µg/day).

Table 7. Risks Resulting from In-field Exposures.

Crop (activity)	Day of Entry	Hours in field	Average body weight (kg)	Average Dose (mg/kg/day)[a]	MOE[b]	90th percentile Dose[a] (mg/kg/day)	MOE[b]
In-field exposure							
corn (harvesting)	4	5.6	62.6	0.00367[c]	**27**	0.0059	**17**
cotton (scouting)	4 or 5	4.5	86.1	0.00072[d]	140	0.00302	**33**
walnuts (harvesting)	14 or 15	6	85.4	0.000199[d]	500	0.000632	160
Exposure extrapolated to 8 hours							
corn (harvesting)	4	5.6	62.6	0.00525[c]	**19**	0.00844	**12**
cotton (scouting)	4 or 5	4.5	86.1	0.00128[d]	**78**	0.00537	**19**
walnuts (harvesting)	14 or 15	6	85.4	0.000265[d]	380	0.000843	120

Footnotes:

a Dose: calculated exposure (µg/day) * (1 mg/1000 µg) * (1/average body weight (kg))

b MOE = Adjusted LOAEL 0.1 mg/kg/day / Dose. Target MOE = 100.

c Geometric mean (Data lognormal distributed)

d Median (Data neither normal nor lognormally distributed).

Short- and Intermediate-term Postapplication Exposures and Risks

A dose and a MOE are determined from the declining predicted DFR values until the target MOE of 100 is reached for every crop for both formulations. Since the short and intermediate- term dermal endpoints are the same, the calculated REIs are for both short- and intermediate-term exposures. The adjusted LOAEL used in the short- and intermediate-term assessment is 0.1 mg/kg/day and the target MOE is 100. For the DFR and MOE values on the day of application and on the day the MOE reached at least 100, see Table 8 for the emulsifiable concentration formulation and Table 9 for the microencapsulate formulation. See Table 10 for a summary of the calculated REIs per crop for both formulations.

Table 8. Methyl Parathion Emulsifiable Concentrate Short- and Intermediate-term Occupational Postapplication Assessment.

Crop[a]	Maximum Label Application Rate (lbs ai/acre)[b]	Transfer Coefficient[c] (cm²/hr)	Activity[d]	DFR Surrogate Data Source[e]	DAT[f]	DFR[g] (µg/cm²)	MOE[h]
corn	0.5	17,000	hand harvesting and detasseling	corn	0	0.92	0.056
					5	0.00033	154
		1,000	irrigating and scouting		0	0.92	0.95
					3	0.0079	110
Alfalfa, Rice, Rye, Oats, Barley, Wheat, Canola, and Sunflower	1	1,500	irrigating and scouting	corn	0	1.53	0.42
					4	0.0024	240
cabbage	1.5	5,000	hand harvesting, irrigating, pruning, and thinning	cabbage	0	1.33	0.046
					13	0.0013	140
		2,000	hand weeding and scouting		0	1.33	0.12
					11	0.0010	100
onion	0.5	2,500	hand harvesting and thinning	cabbage	0	1.33	0.28
					10	0.0027	130
		300	irrigating, scouting, hand weeding, and pruning		0	1.33	2.32
					7	0.00059	170
white potato	1.5	1,500	irrigating and scouting	cabbage	0	1.33	0.15
					11	0.0044	130
		300	hand weeding		0	1.33	0.77
					8	0.028	110
sugar beets	0.375	1,500	irrigating and scouting	cabbage	0	0.94	0.62
					9	0.0034	160
		100	hand weeding and thinning		0	0.94	9.3

Crop[a]	Maximum Label Application Rate (lbs ai/acre)[b]	Transfer Coefficient[c] (cm^2/hr)	Activity[d]	DFR Surrogate Data Source[e]	DAT[f]	DFR[g] ($\mu g/cm^2$)	MOE[h]
					4	0.081	110
cotton and soybeans	0.75	1,500	scouting and irrigating	cotton	0	1.08	0.54
					6	0.17	100
hops	1.0	2,000	hand and mechanical harvesting, training, hand weeding, and striping	cotton	0	1.43	0.30
					16	0.0044	100
		1,300	scouting		0	1.43	0.47
					9	0.0065	100
dried peas	1.0	2,500	hand harvest	cotton	0	1.43	0.24
					20	0.0035	100
		1,500	irrigating and scouting		0	1.43	0.41
					11	0.0058	100
dried beans	1.5	2,500	hand harvest	cotton	0	2.15	0.16
					27	0.0055	100
		1,500	irrigating and scouting		0	2.15	0.27
					19	0.0035	110

Footnotes:

a Crops were grouped according to similar application rates, transfer coefficients, and surrogate DFR data sources.

b Maximum application rates as stated on current methyl parathion labels or reduced application rates as agreed upon by the registrant..

c Transfer Coefficients from Science Advisory Council on Exposure Policy 3.1.[23]

d Activities from Science Advisory Council on Exposure Policy 3.1.[23] Every activity listed may not occur for every crop in the group.

e The appropriate DFR surrogate data source for each crop was determined by the similarity in crop types.

f DAT is "days after treatment"

g Predicted DFR values were obtained through study data of methyl parathion emulsifiable concentrate residues on the foliage of cotton, cabbage and corn. DFR values were adjusted proportionately to reflect different application rates. The adjusted DFR = (study DFR X crop application rate)/study application rate. The LOQ for the DFR studies was 0.005 $\mu g/cm^2$ and the LOD was 0.002 $\mu g/cm^2$. Many of the DFR values were near or below the LOQ on the day the MOE reached 100.

h MOE = Adjusted LOAEL (mg/kg/day) / Dermal dose (mg/kg/day). Target MOE = 100.

Table 9. Methyl Parathion Microencapsulate Short- and Intermediate-term Occupational Postapplication Assessment.

Crop[a]	Maximum Label Application Rate (lbs ai/acre)[b]	Transfer Coefficient[c] (cm²/hr)	Activity[d]	DFR Surrogate Data Source[e]	DAT[f]	DFR[g] (µg/cm²)	MOE[h]
corn	0.75	12,000 (45800101 study)	hand harvesting and detasseling	corn	0	1.18	0.062
					52	0.00063	110
		640 (45204701 study)	irrigating and scouting		0	1.18	1.16
					31	0.013	100
Rice, Rye, Oats, Barley, and Wheat	0.75	640 (45204701 study)	irrigating and scouting	corn	0	1.18	1.16
					31	0.013	100
cotton	1.0	640 (45204701 study)	scouting	cotton	0	1.52	0.90
					11	0.012	110
white potato	1.5	640 (45204701 study)	irrigating and scouting	cotton	0	2.27	0.60
					12	0.012	110
		300	hand weeding		0	2.27	1.28
					10	0.029	100
soybeans	0.75	640 (45204701 study)	irrigating and scouting	cotton	0	1.14	1.2
					11	0.0093	150
dried beans and sweet potatoes	1.0	2,500	hand harvesting	cotton	0	1.52	0.23
					14	0.0034	100
		640 (45204701 study)	irrigating and scouting		0	1.52	0.90
					11	0.012	110

Crop[a]	Maximum Label Application Rate (lbs ai/acre)[b]	Transfer Coefficient[c] (cm²/hr)	Activity[d]	DFR Surrogate Data Source[e]	DAT[f]	DFR[g] (µg/cm²)	MOE[h]
dried peas, onions, and lentils	0.5	1,500	hand harvesting	cotton	0	0.76	0.46
					13	0.0026	130
		640 (45204701 study)	irrigating and scouting (except for onions)		0	0.76	1.8
					10	0.0097	140
onions	1.0	300	irrigating and scouting	cotton	0	0.76	3.8
					8	0.023	130
walnuts, almonds, and pecans (exposure to the foliage)	2.0	49 (45391501 study)	hand harvest (shaking trees, hand raking the nuts, mechanically blowing and sweeping nuts into windrows)	cotton DFR data	0	1.5	12
					25	0.17	110
walnuts, almonds and pecans (exposure to soil)	2.0	3 (g dry soil/hour) (45391501 study)	hand harvest (shaking trees, hand raking the nuts, mechanically blowing and sweeping nuts into windrows)	cotton soil residue data	0	8.7 (µg/g dry soil)	34
					14	0.99 (µg/g dry soil)	110

Footnotes:

a Crops were grouped according to similar application rates, transfer coefficients, and surrogate DFR data sources.

b Maximum application rates as stated on current methyl parathion labels or reduced application rates as agreed upon by the registrant..

c Transfer Coefficients from chemical specific studies, when noted, otherwise are from Science Advisory Council on Exposure Policy 3.1.[23]

d Activities from Science Advisory Council on Exposure Policy 3.1.[23] Every activity listed may not occur for every crop in the group.

e The appropriate DFR surrogate data source for each crop was determined by the similarity in crop types.

f DAT is "days after treatment"

g Predicted DFR values were obtained through study data of methyl parathion emulsifiable concentrate residues on the foliage of cotton, cabbage and corn. DFR values were adjusted proportionately to reflect different application rates. The adjusted DFR = (study DFR X crop application rate)/study application rate. The LOQ for the DFR studies was 0.01 µg/cm², although selected samples were analyzed using a modified method, which has a LOQ of 0.001 µg/cm². Many of the DFR values were near or below the LOQ on the day the MOE reached 100.

h MOE = Adjusted LOAEL (mg/kg/day) / Dermal dose (mg/kg/day). Target MOE = 100.

Data Gaps

If the registrant is interested in refining methyl parathion's restricted entry intervals, additional DFR data and/or worker exposure monitoring data may be submitted.

Data Quality and Confidence in the Assessment

All REIs calculated in this assessment used chemical specific DFR data. Three sites were tested per crop for both formulations, and the DFR data from the site that resulted in the highest half life value was used, since no trend in climate and half life could be determined. Three DFR studies were translated to 16 other crops for both formulations. Three foliage and one soil microencapsulate chemical specific transfer coefficients were used in this assessment. All other transfer coefficients were from the Transfer Coefficient Science Advisory Council on Exposure Policy 3.1, which is based on activity specific studies submitted by the Agriculture Reentry Task Force (ARTF).

Occupational Postapplication Worker Summary

For short and intermediate term exposure to the emulsifiable concentrate formulation, the day after treatment when the calculated MOE equals or exceeds the target MOE of 100 (REI) ranges from 4 to 27 days. For short and intermediate term exposures to the microencapsulate formulation, the day after treatment when the calculated MOE equals or exceeds the target MOE of 100 (REI) ranges from 8 to 52 days. Occupational postapplication risks from dermal exposure are of concern. See Table 10 for a summary. The half lives and subsequent REI calculations of the microencapsulate formulation are longer than those for the emulsifiable concentrate formulation. This most likely occurred because the polymeric-type microcapsules are designed to slowly release the active ingredient over time.

Worker exposure from entering the treated fields in the three biomonitoring postapplication microencapsulate studies results in a risk of concern at both the average dose and the 90th percentile dose for hand harvesting sweet corn and cotton scouting is a risk of concern at the 90th percentile dose. For exposures from these studies that were extrapolated to an eight hour work day, corn harvesting and cotton scouting are a risk of concern at both the average dose and the 90th percentile dose.

Table 10. Summary of Calculated Short and Intermediate term REIs

Crop	Microencapsulate			Emulsifiable Concentrate		
	Application Rate (lb ai/acre)	Transfer Coefficient[a] (cm²/hr)	REI[b]	Application Rate (lb ai/acre)	Transfer Coefficient[a] (cm²/hr)	REI[b]
alfalfa	NA			1	1,500	4
almonds	2	**49[c]**	25	NA		
		3[c] (g dry soil/hour)	14 (soil)			
barley	0.75	**640[d]**	31	0.75	1,500	4
beans, dried	1	2,500	14	1.5	2,500	27
		640[d]	11		1,500	19
cabbage	NA			1.5	5,000	13
					2,000	11
corn	1	**12,000[e]**	52	0.5	17,000	5
		640[d]	31		1,000	3
cotton	1	**640[d]**	11	0.75	1,500	6
hops	NA			1	2,000	16
					1,300	9
lentils	0.5	1,500	13	NA		
		640[d]	10			
oats	0.75	**640[d]**	31	0.75	1,500	4
onions	0.5	1,500	13	0.5	2,500	10
		300	8		300	7
peas, dried	0.5	1,500	13	1	2,500	20
		640[d]	10		1,500	11
pecans	2	**49[c]**	25	NA		
		3[c] (g dry soil/hour)	14 (soil)			
canola	NA			0.5	1,500	4
rice	0.75	**640[d]**	31	0.75	1,500	4
rye	NA	**640[d]**	31	0.75	1,500	4
soybeans	0.75	**640[d]**	11	0.75	1,500	6
sugar beets	NA			0.375	1,500	9

Crop	Microencapsulate			Emulsifiable Concentrate		
	Application Rate (lb ai/acre)	**Transfer Coefficient[a] (cm^2/hr)**	**REI[b]**	**Application Rate (lb ai/acre)**	**Transfer Coefficient[a] (cm^2/hr)**	**REI[b]**
					100	4
sunflower	NA			1	1,500	4
sweet potato	0.75	2,500	14	NA		
		640[d]	11			
walnuts	2	**49[c]**	25	NA		
		3[c] (g dry soil/hour)	14 (soil)			
wheat	0.75	**640[d]**	31	1.5	1,500	4
white potato	1.5	**640[d]**	12	1.5	1,500	11
		300	10		300	8

Footnotes:

a Transfer Coefficients from chemical specific studies, when noted, otherwise are from Science Advisory Council on Exposure Policy 3.1.[16] Activities that they transfer coefficient represent are listed in Tables 8 and 9.

b REI is set on the day after application when the calculated MOE is greater than the target MOE of 100.

c Transfer coefficient from microencapsulate walnut harvesting study MRID # 45391501.

d Transfer coefficient from microencapsulate cotton scouting study MRID # 45204701.

e Transfer coefficient form microencapsulate sweet corn hand harvesting study MRID # 45800101.

NA = use on crop does not exist for the formulation.

RESIDENTIAL EXPOSURE AND RISK ASSESSMENT FOR THE USE OF METHYL PARATHION

Although methyl parathion is a restricted use pesticide that is only to be applied by certified applicators, HED believes that residential exposures may occur from spray drift from the application of methyl parathion to agricultural fields. Spray drift is always a potential source of exposure to residents nearby to spraying operations. This is particularly the case with aerial application, but, to a lesser extent, could also be a potential source of exposure from ground application methods. The Agency has been working with the Spray Drift Task Force, EPA Regional Offices and State Lead Agencies for pesticide regulation and other parties to develop the best spray drift management practices. The Agency is now requiring interim mitigation measures for aerial applications that must be placed on product labels/labeling. The Agency has completed its evaluation of the new data base submitted by the Spray Drift Task Force, a membership of U.S. pesticide registrants, and is developing a policy on how to appropriately apply the data and the AgDRIFT computer model to its risk assessments for pesticides applied by air, orchard airblast and ground hydraulic methods. After the policy is in place, the Agency may impose further refinements in spray drift management practices to reduce off-target drift and risks associated with aerial as well as other application types where appropriate.

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3) Currently registered methyl parahion labels.

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Appendix

Table A. Example Unit Exposure Calculation from Mixer/loader Microencapsulate Study (MRID 45327101)

Site	Worker ID		Pre screen	-24 to -48 hours	-24 to 0 hours	0 to 24 hours	24 to 48 hours	48 to 72 hours	72 to 84 hours						
MS	1	4NP found (ug)	4.62	1.84	5.5	24.1	10	4.16	4.44						
MS	1	4NP found (ug) FR corrected	6.06	2.41	7.21	31.61	13.11	5.46	5.82	**lb ai applied**	350				
MS	1	creatinine (g/24hr)	1.45	2.26	2	1.93	2.23	1.35	2.05	average creatinine (g/24 hr)	1.90	prescreen through 84 hrs			
MS	1	4NP corrected (ug)	7.92	1.54	5.21	23.67	8.50	5.84	4.11	Baseline 4NP corrected (ug)	3.38	average of day -1 and -2			
MS	1	4NP minus baseline (ug)				20.29	5.12	2.46	0.73	**total 4NP (ug)**	28.6	**total MP (ug)**	75.1	**total MP per lb applied (ug/ab ai)**	0.215
MS	2	4NP found (ug)	2.04	3.92	3.39	12.7	9.42	5.71	2.26						
MS	2	4NP found (ug) FR corrected	2.68	5.14	4.45	16.66	12.35	7.49	2.96	**lb ai applied**	350				
MS	2	creatinine (g/24hr)	2.38	2.31	2.23	1.62	2.65	2.57	1.33	average creatinine (g/24 hr)	2.16	prescreen through 84 hrs			
MS	2	4NP corrected (ug)	2.42	4.80	4.30	22.16	10.05	6.28	4.80	Baseline 4NP corrected (ug)	4.55	average of day -1 and -2			
MS	2	4NP minus baseline (ug)				17.62	5.50	1.73	0.26	**total 4NP (ug)**	25.1	**total MP (ug)**	65.9	**total MP per lb applied (ug/ab ai)**	0.188
MS	3	4NP found (ug)	6.84	2.72	3.47	7.48	4.82	4.86	1.27						
MS	3	4NP found (ug) FR corrected	8.97	3.57	4.55	9.81	6.32	6.37	1.67	**lb ai applied**	350				
MS	3	creatinine (g/24hr)	1.44	1.34	1.14	1.28	0.508	1.9	0.53	average creatinine (g/24 hr)	1.16	prescreen through 84 hrs			
MS	3	4NP corrected (ug)	7.24	3.10	4.64	8.91	14.47	3.90	3.64	Baseline 4NP corrected (ug)	3.87	average of day -1 and -2			
MS	3	4NP minus baseline (ug)				5.04	10.60	0.03	0.00	**total 4NP (ug)**	15.7	**total MP (ug)**	41.2	**total MP per lb applied (ug/ab ai)**	0.118

Site	Worker ID		Pre screen	-24 to -48 hours	-24 to 0 hours	0 to 24 hours	24 to 48 hours	48 to 72 hours	72 to 84 hours						
MS	4	4NP found (ug)	2.61	3.71	3.72	10.2	26.9	5.95	2.95						
MS	4	4NP found (ug) FR corrected	3.42	4.87	4.88	13.38	35.28	7.80	3.87	**lb ai applied**	350				
MS	4	creatinine (g/24hr)	1.84	1.86	1.72	1.73	2.42	2.26	1.40	average creatinine (g/24 hr)	1.89	prescreen through 84 hrs			
MS	4	4NP corrected (ug)	3.52	4.94	5.36	14.61	27.55	6.53	5.22	Baseline 4NP corrected (ug)	5.15	average of day -1 and -2			
MS	4	4NP minus baseline (ug)				9.46	22.40	1.37	0.07	**total 4NP (ug)**	33.3	**total MP (ug)**	87.43	**total MP per lb applied (ug/ab ai)**	0.250
MS	5	4NP found (ug)	4.26	7.54	3.64	19	9.4	7.47	2.93						
MS	5	4NP found (ug) FR corrected	5.59	9.89	4.77	24.92	12.33	9.80	3.84	**lb ai applied**	350				
MS	5	creatinine (g/24hr)	2.1	1.86	1.84	2.82	3.48	4.01	1.22	average creatinine (g/24 hr)	2.48	prescreen through 84 hrs			
MS	5	4NP corrected (ug)	6.59	13.16	6.42	21.88	8.77	6.05	7.80	Baseline 4NP corrected (ug)	9.79	average of day -1 and -2			
MS	5	4NP minus baseline (ug)				12.08	0.00	0.00	0.00	**total 4NP (ug)**	12.1	**total MP (ug)**	31.7	**total MP per lb applied (ug/ab ai)**	0.091
Gila, AZ	6	4NP found (ug)	13	4.04	5.28	53.7	17.3	12.1	4.95						
Gila, AZ	6	4NP found (ug) FR corrected	14.99	4.66	6.09	61.94	19.95	13.96	5.71	**lb ai applied**	350				
Gila, AZ	6	creatinine (g/24hr)	2.94	2.28	1.95	2.72	2.51	2.3	1.00	average creatinine (g/24 hr)	2.24	prescreen through 84 hrs			
Gila, AZ	6	4NP corrected (ug)	11.44	4.58	7.00	51.07	17.83	13.61	12.82	Baseline 4NP corrected (ug)	5.79	average of day -1 and -2			
Gila, AZ	6	4NP minus baseline (ug)				45.28	12.04	7.81	7.02	**total 4NP (ug)**	72.2	**total MP (ug)**	189	**total MP per lb applied (ug/ab ai)**	0.541

Site	Worker ID		Pre screen	-24 to -48 hours	-24 to 0 hours	0 to 24 hours	24 to 48 hours	48 to 72 hours	72 to 84 hours						
Gila, AZ	7	4NP found (ug)	3.64	1.74	6.66	28	10.3	7.03	4.29						
Gila, AZ	7	4NP found (ug) FR corrected	4.20	2.01	7.68	32.30	11.88	8.11	4.95	**lb ai applied**	350				
Gila, AZ	7	creatinine (g/24hr)	1.06	1.83	1.53	1.66	1.66	1.8	0.58	average creatinine (g/24 hr)	1.45	prescreen through 84 hrs			
Gila, AZ	7	4NP corrected (ug)	5.73	1.59	7.26	28.13	10.35	6.51	12.31	Baseline 4NP corrected (ug)	4.42	average of day -1 and -2			
Gila, AZ	7	4NP minus baseline (ug)				23.71	5.93	2.09	7.89	**total 4NP (ug)**	39.6	**total MP (ug)**	104	**total MP per lb applied (ug/ab ai)**	0.297
Gila, AZ	8	4NP found (ug)	5.32	4.58	6.78	47.3	17.4	12.1	3.94						
Gila, AZ	8	4NP found (ug) FR corrected	6.14	5.28	7.82	54.56	20.07	13.96	4.54	**lb ai applied**	350				
Gila, AZ	8	creatinine (g/24hr)	0.894	2.38	2.99	1.93	3.26	3.28	0.91	average creatinine (g/24 hr)	2.23	prescreen through 84 hrs			
Gila, AZ	8	4NP corrected (ug)	15.33	4.96	5.84	63.15	13.75	9.51	11.22	Baseline 4NP corrected (ug)	5.40	average of day -1 and -2			
Gila, AZ	8	4NP minus baseline (ug)				57.75	8.35	4.11	5.82	**total 4NP (ug)**	76.0	**total MP (ug)**	200	**total MP per lb applied (ug/ab ai)**	0.570
Gila, AZ	9	4NP found (ug)	1.94	2	3.54	19.8	9.22	4	4.61						
Gila, AZ	9	4NP found (ug) FR corrected	2.24	2.31	4.08	22.84	10.63	4.61	5.32	**lb ai applied**	350				
Gila, AZ	9	creatinine (g/24hr)	1.05	1.46	1.61	1.54	1.85	1	1.29	average creatinine (g/24 hr)	1.40	prescreen through 84 hrs			
Gila, AZ	9	4NP corrected (ug)	2.98	2.21	3.55	20.76	8.05	6.46	5.77	Baseline 4NP corrected (ug)	2.88	average of day -1 and -2			
Gila, AZ	9	4NP minus baseline (ug)				17.88	5.17	3.58	2.89	**total 4NP (ug)**	29.5	**total MP (ug)**	77.5	**total MP per lb applied (ug/ab ai)**	0.221

Site	Worker ID		Pre screen	-24 to -48 hours	-24 to 0 hours	0 to 24 hours	24 to 48 hours	48 to 72 hours	72 to 84 hours						
Gila, AZ	10	4NP found (ug)	5.72	2.61	3.68	38.4	11.5	9.29	5.83						
Gila, AZ	10	4NP found (ug) FR corrected	6.60	3.01	4.24	44.29	13.26	10.72	6.72	**lb ai applied**	350				
Gila, AZ	10	creatinine (g/24hr)	1.36	1.74	2.41	1.72	1.7	1.59	1.21	average creatinine (g/24 hr)	1.68	prescreen through 84 hrs			
Gila, AZ	10	4NP corrected (ug)	8.13	2.90	2.95	43.15	13.07	11.29	9.31	Baseline 4NP corrected (ug)	2.93	average of day -1 and -2			
Gila, AZ	10	4NP minus baseline (ug)				40.23	10.15	8.37	6.39	**total 4NP (ug)**	65.1	**total MP (ug)**	171	**total MP per lb applied (ug/ab ai)**	0.489
H. Valley, AZ	11	4NP found (ug)	6.94	5.78	9.82	14.7	6.37	6.67	5.40	**lb ai applied**	350				
H. Valley, AZ	11	creatinine (g/24hr)	1.83	2.11	2.21	2.13	2.05	1.4	0.87	average creatinine (g/24 hr)	1.80	prescreen through 84 hrs			
H. Valley, AZ	11	4NP corrected (ug)	6.83	4.93	8.00	12.42	5.59	8.57	11.20	Baseline 4NP corrected (ug)	6.46	average of day -1 and -2			
H. Valley, AZ	11	4NP minus baseline (ug)				5.96	0.00	2.11	4.73	**total 4NP (ug)**	12.8	**total MP (ug)**	33.6	**total MP per lb applied (ug/ab ai)**	0.096
H. Valley, AZ	12	4NP found (ug)	2.9	3.95	4.74	12.3	4.25	8.02	3.55	**lb ai applied**	350				
H. Valley, AZ	12	creatinine (g/24hr)	0.86	1.49	1.3	2.56	1.54	1.54	0.75	average creatinine (g/24 hr)	1.43	prescreen through 84 hrs			
H. Valley, AZ	12	4NP corrected (ug)	4.84	3.80	5.23	6.89	3.96	7.47	6.76	Baseline 4NP corrected (ug)	4.52	average of day -1 and -2			
H. Valley, AZ	12	4NP minus baseline (ug)				2.38	0.00	2.95	2.24	**total 4NP (ug)**	7.57	**total MP (ug)**	19.9	**total MP per lb applied (ug/ab ai)**	0.0568

Site	Worker ID		Pre screen	-24 to -48 hours	-24 to 0 hours	0 to 24 hours	24 to 48 hours	48 to 72 hours	72 to 84 hours						
H. Valley, AZ	13	4NP found (ug)	6.33	3.77	4.75	15.4	3.43	3.98	2.71	**lb ai applied**	350				
H. Valley, AZ	13	creatinine (g/24hr)	2.33	1.65	1.47	1.98	1.57	2.16	0.85	average creatinine (g/24 hr)	1.72	prescreen through 84 hrs			
H. Valley, AZ	13	4NP corrected (ug)	4.66	3.92	5.54	13.34	3.75	3.16	5.49	Baseline 4NP corrected (ug)	4.73	average of day -1 and -2			
H. Valley, AZ	13	4NP minus baseline (ug)				8.61	0.00	0.00	0.76	**total 4NP (ug)**	9.37	**total MP (ug)**	24.6	**total MP per lb applied (ug/ab ai)**	0.0703
H. Valley, AZ	14	4NP found (ug)	7.91	9.33	7.19	12.6	8.07	7.23	4.48	**lb ai applied**	350				
H. Valley, AZ	14	creatinine (g/24hr)	1.1	1.63	1.89	2.24	2.13	1.6	0.64	average creatinine (g/24 hr)	1.60	prescreen through 84 hrs			
H. Valley, AZ	14	4NP corrected (ug)	11.53	9.18	6.10	9.02	6.08	7.25	11.28	Baseline 4NP corrected (ug)	7.64	average of day -1 and -2			
H. Valley, AZ	14	4NP minus baseline (ug)				1.38	0.00	0.00	3.64	**total 4NP (ug)**	5.02	**total MP (ug)**	13.2	**total MP per lb applied (ug/ab ai)**	0.0376
H. Valley, AZ	15	4NP found (ug)	4.96	8.46	5.92	9.8	5.09	4.89	2.87	**lb ai applied**	350				
H. Valley, AZ	15	creatinine (g/24hr)	1.87	1.95	1.98	1.74	1.38	2.18	1.07	average creatinine (g/24 hr)	1.74	prescreen through 84 hrs			
H. Valley, AZ	15	4NP corrected (ug)	4.61	7.54	5.20	9.79	6.41	3.90	4.66	Baseline 4NP corrected (ug)	6.37	average of day -1 and -2			
H. Valley, AZ	15	4NP minus baseline (ug)				3.42	0.04	0.00	0.00	**total 4NP (ug)**	3.46	**total MP (ug)**	9.09	**total MP per lb applied (ug/ab ai)**	0.0260

Site	Worker ID		Pre screen	-24 to -48 hours	-24 to 0 hours	0 to 24 hours	24 to 48 hours	48 to 72 hours	72 to 84 hours						
H. Valley, AZ	16	4NP found (ug)	5.32	6.11	7.19	8.29	3.72	5.68	1.67	**lb ai applied**	350				
H. Valley, AZ	16	creatinine (g/24hr)	0.894	2.98	2.42	2.14	2.98	2.59	1.39	average creatinine (g/24 hr)	2.20	prescreen through 84 hrs			
H. Valley, AZ	16	4NP corrected (ug)	13.09	4.51	6.53	8.52	2.75	4.82	2.64	Baseline 4NP corrected (ug)	5.52	average of day -1 and -2			
H. Valley, AZ	16	4NP minus baseline (ug)				3.00	0.00	0.00	0.00	**total 4NP (ug)**	3.00	**total MP (ug)**	7.87	**total MP per lb applied (ug/ab ai)**	0.0225

Footnotes:

Prescreen: 24 hour urine sample taken approximately 2 weeks before the start of the study.

4NP found: amount of metabolite (4NP) found in the 24 hour urine sample.

4NP found FR corrected: 4NP found corrected for field recovery (Field recovery: 76.25% MS, 86.7% Gila, AZ).

Creatinine: amount of creatinine found in each 24 hour sample

Average creatinine: Average of the daily creatinine level prescreen through 84 hours after exposure.

4NP corrected: (4NP found FR corrected/creatinine) * average creatinine

Baseline 4NP corrected: average of the 4NP corrected value for the two days prior to exposure (-48 to -24 hours and -24 to 0 hours).

4NP minus baseline: 4NP corrected values for each day after exposure minus the baseline 4NP corrected value.

Total 4NP: sum of all 4NP minus baseline values.

Total MP: total 4NP value corrected for molecular weight and metabolism (Total 4NP * (1.89) * (100/72))

Total MP per lb applied: total MP divided by lbs ai applied by worker.

All negative 4NP minus baseline values were considered and reported as zero values.

Table B. Calculated Unit Exposure Values from Handler Biomonitoring Studies

ME ML at AR&LA (MRID 45513001)	**(B)**						
ME ML at MS&AZ (MRID 45327101)	**(A)**		**EC ML (MRID 45527601)**			**ME Groundboom Applicator (MRID 45513001)**	
Worker ID	**MP (ug/lb ai)**		**Worker ID**	**MP (ug/lb ai)**		**Worker ID**	**MP (ug/lb ai)**
1A	0.2146		1	0.0160		1	3.1427
2A	0.1883		2	0.0976		2	0.6433
3A	0.1176		3	0.0383		3	0.4444
4A	0.2498		4	0.2350		4	0.9209
5A	0.0906		5	**0.0001**		5	0.5790
6A	0.5411		6	0.1488		6	2.4117
7A	0.2971		7	0.0225		7	0.3673
8A	0.5702		8	0.0571		8	0.0576
9A	0.2214		9	**0.0001**		9	0.3261
10A	0.4885		10	0.0056		10	0.2367
11A	0.0960		11	**0.0001**		11	0.5653
12A	0.0568		12	0.0085		12	0.0668
13A	0.0703		13	0.0083		13	1.0321
14A	0.0376		14	0.0597		14	0.5840
15A	0.0260		15	0.0819		15	0.2620
16A	0.0225		16	0.1537			
12B	0.4982						
14B	0.0433						
16B	**0.0001**						
19B	0.1414						
20B	**0.0001**						
3B	0.9558						
4B	0.8082						
7B	1.3076						
8B	1.4841						
10B	0.5213						
arithmetic mean	0.348			0.058			0.776
geometric mean	0.113			0.013			**0.468**
median	**0.201**			**0.030**			0.565
distribution type	not normal or lognormal			not normal or lognormal			lognormal
Range	0 to 1.48			0 to 0.235			0.0576 to 3.14
50 percentile	0.201			0.0304			0.565
75 percentile	0.516			0.0858			0.782
90 percentile	0.882			0.151			1.86

<u>Footnotes:</u>

PPE: all workers are wearing double layer of clothing (coveralls), gloves and a dust/mist respirator.

The EC formulation was packaged in a Micromatic “DV” liquid transfer closed mixing/loading system

The microencapsulate studies were done with open mixing/loading and open cab tractors.

The statistical distribution of this data was then determined using the *W* test, developed by Shapiro and Wilk. If the data were determined to be lognormally distributed, then the geometric mean was used. If the data were determined to be normally distributed, then the arithmetic mean was used and if the data were neither log normally or normally distributed, then the median was used. (Average used in assessment in bold).

0.0001 values shown (bolded) are zero values, but the 0.0001 value was used since the geometric mean cannot be calculated using zero values.

Table C. Calculated Postapplication Exposures and Transfer Coefficients.

Corn Harvesting Florida		Cotton Scouting						DFR Walnut Harvesting				Soil Residues Walnut Harvesting			
		Texas		Louisiana		California		Fresno		Porterville		Fresno		Porterville	
Worker ID	**MP (ug/hour)**	**Worker ID**	**MP (ug/hour)**	**Worker ID**	**MP (ug/hour)**	**Worker ID**	**MP (ug/hour)**	**Worker ID**	**MP (ug/hour)**	**Worker ID**	**MP (ug/hour)**	**Worker ID**	**MP (ug/hour)**	**Worker ID**	**MP (ug/hour)**
1	110.7	1T	11.57	1L	21.61	1C	17.78	1F	1.18	9P	10.31	1F	1.18	9P	10.31
2	33.47	2T	0.32	2L	57.17	3C	56.20	2F	4.43	10P	6.99	2F	4.43	10P	6.99
3	21.30	3T	8.76	3L	19.22	4C	13.85	3F	2.33	11P	2.87	3F	2.33	11P	2.87
4	50.16	4T	5.88	4L	30.46	7C	**0.0001**	4F	**0.0001**	12P	4.24	4F	**0.0001**	12P	4.24
5	34.71	5T	7.70	5L	**0.0001**	10C	191.74	5F	**0.0001**	13P	4.11	5F	**0.0001**	13P	4.11
6	37.01							6F	4.27	14P	1.65	6F	4.27	14P	1.65
8	18.85							7F	**0.0001**	15P	11.48	7F	**0.0001**	15P	11.48
9	42.12							8F	0.58			8F	0.58		
10	24.97														
11	58.64														
12	69.62														
13	52.72														
14	26.40														
15	63.77														
16	37.55														
17	47.91														
arithmetic mean	45.62		**6.85**		**25.69**		**55.92**		1.60		**5.95**		1.60		**5.95**
geometric mean	**41.08**		4.29		2.35		3.05		0.05		4.90		0.05		4.90
median	39.84		7.70		21.61		17.78		**0.88**		4.24		**0.88**		4.24
distribution type	lognormal		Normal		Normal		Normal		Not normal or lognormal		Normal		Not normal or lognormal		Normal
Range	18.85 to 110.7		11.57 to 0.32		0 to 57.17		0 to 191.74		0 to 4.43		1.65 to 11.48		0 to 4.43		1.65 to 11.48
50 percentile	39.8		7.7		21.6		17.8		0.9		4.2		0.9		4.2
75 percentile	54.2		8.8		30.5		56.2		2.8		8.6		2.8		8.6
90 percentile	66.7		10.4		46.5		137.5		4.3		10.8		4.3		10.8
day of entry	4		4		4		5		14		15		14		15
residue at site on day of entry (ug/cm2)	0.00348		0.0994		0.0164		0.1937		0.319		0.063		3.19		0.921 ug/g dry soil
application rate (lb ai/acre)	0.75		1		1		1		2		2		2		2
tc (cm2/hour) average	**12,000**		70		1570		290		3		94		0.28		6.5 g dry soil/ hour
tc (cm2/hour) 90th	19,000		105		2800		710		14		170		1.4		12 g dry soil/ hour
		average Tc for cotton scouting				640		**average for walnut**			49	**average for walnut harvesting**			3

		(average)			**harvesting (average)**		**(average)**
		average Tc for cotton scouting (90th)	1,200		**average for walnut harvesting (90th)**	92	**average f (g dry soi**

Footnotes:

PPE: all workers are wearing long sleeves, long pants, shoes and socks.

The statistical distribution of this data was then determined using the *W* test, developed by Shapiro and Wilk. If the data were determined to be lognormally distributed, then the geometric mean was used. If the data were determined to be normally distributed, then the arithmetic mean was used and if the data were neither log normally or normally distributed, then the median was used.(Average used in assessment in bold).

0.0001 values shown (bolded) are zero values, but the 0.0001 value was used since the geometric mean cannot be calculated using zero values.

If there was more than one site for an activity, those transfer coefficients were average together.

Transfer coefficients were calculated for both soil and foliage exposure for walnut harvesting. Since it cannot be determined which medium (soil or foliage) the exposure occurred, it was assumed that the all exposure occurred from either soil or foliage in order to determine a transfer coefficient.

Foliage Transfer coefficient (cm^2/hour) = exposure (µg/hour)/DFR value for site and day of exposure (µg/cm^2)

Soil Transfer coefficient (g dry soil/hour) = exposure (µg/hour)/soil residue value for site and day of exposure (µg/g dry soil)

Table D. Calculated Microencapsulated Exposure Values for Postapplication Activities.

corn harvesting		cotton scouting		walnut harvesting	
Worker ID	**MP (ug)**	**Worker ID**	**MP (ug)**	**Worker ID**	**MP (ug)**
1	619.96	1	52.08	1	6.25
2	187.45	2	1.43	2	26.57
3	119.27	3	39.40	3	13.96
4	280.89	4	26.47	4	**0.0001**
5	194.40	5	34.66	5	**0.0001**
6	207.27	1	91.84	6	25.63
8	105.55	2	257.27	7	**0.0001**
9	235.89	3	86.47	8	3.45
10	139.86	4	137.08	9	61.83
11	328.38	5	**0.0001**	10	41.92
12	389.88	1	80.03	11	17.21
13	295.26	3	252.89	12	25.43
14	147.82	4	62.33	13	24.65
15	357.09	7	**0.0001**	14	9.48
16	210.30	10	862.84	15	68.90
17	268.30				
arithmetic mean	260		130		22
geometric mean	**230**		12		1.7
median	220		**62**		**17**
distribution type	lognormal		not normal or lognormal		not normal or lognormal
Range	110 to 680		0 to 860		0 to 69
50 percentile	220		62		17
75 percentile	300		115		26
90 percentile	370		260		54

Footnotes:

PPE: all workers are wearing long sleeves, long pants, shoes and socks.

The statistical distribution of this data was then determined using the *W* test, developed by Shapiro and Wilk. If the data were determined to be lognormally distributed, then the geometric mean was used. If the data were determined to be normally distributed, then the arithmetic mean was used and if the data were neither log normally or normally distributed, then the median was used.(Average used in assessment in bold).

0.0001 values shown (bolded) are zero values, but the 0.0001 value was used since the geometric mean cannot be calculated using zero values.

Values not separated out by site, data used to calculate MOEs to the workers per activity.

Time in field: corn harvesting 5.6 hours, cotton scouting 4.5 hours and walnut harvesting 6 hours.

Table E. Occupational Short-Term and Intermediate-Term Dermal and Inhalation Exposure to Methyl Parathion and Doses at Baseline.

Exposure Scenario (Scenario #)	Unit Exposure Data Source[a]	Baseline Dermal Unit Exposure (mg/lb ai)[b]	Baseline Inhalation Unit Exposure (µg/lb ai)[c]	Maximum Application Rate (lb ai/acre)[d]	Crop[e]	Daily Acres Treated[f]	Baseline Dermal Dose (mg/kg/day)[g]	Baseline Inhalation Dose (mg/kg/day)[h]	Dermal MOE[i]	Inhalation MOE[j]	Total Short and Int-term MOE[k]
Mixer/Loader Exposure											
Mixing/Loading Liquids (EC and ME formulations) for Aerial/Chemigation Application (1a)	PHED (liquid used as a surrogate for M/L the ME formulation)	2.9	1.2	0.375	sugar beets	350	5.4	0.0023	0.018	49	0.018
				1.0	Alfalfa		14.5	0.0060	0.0069	18	0.0069
				2.0	Walnut		29	0.0120	0.0034	9	0.0034
				0.5	Corn	1200	24.9	0.0103	0.0040	11	0.0040
				1.0	Alfalfa		49.7	0.0206	0.0020	5	0.0020
Mixing/Loading Liquids (EC and ME formulation) for Groundboom Application (1b)				0.375	sugar beets	80	1.2	0.0005	0.081	210	0.080
				1.5	Potato		5	0.0021	0.0201	53	0.020
				0.5	Corn	200	4.1	0.0017	0.0241	64	0.024
				1.0	Alfalfa		8.3	0.0034	0.0121	32	0.012
Mixing/Loading Liquids (ME formulation) for Airblast Sprayer (1c)				2.0	Walnut	40	3.3	0.0014	0.0302	80	0.030
Mixing/Loading Liquids (EC formulations) for Aerial Application (2a)	Study (45527601) median	ND	ND	0.375	sugar beets	350	ND	ND	ND	ND	ND
				1.5	Potato						
				0.5	Corn	1200					
				1.0	Alfalfa						
Mixing/Loading Liquids (EC formulation) for Aerial Application (2b)	Study (45527601) 90[th] percentile	ND	ND	0.375	sugar beets	350	ND	ND	ND	ND	ND
				1.5	potato						
				0.5	Corn	1200					
				1.0	Alfalfa						
Mixing/Loading Liquids (EC formulations) for Groundboom Application (2c)	Study (45527601) median	ND	ND	0.375	sugar beets	80	ND	ND	ND	ND	ND
				1.5	potato						
				0.5	Corn	200					
				1.0	Alfalfa						

Exposure Scenario (Scenario #)	Unit Exposure Data Source[a]	Baseline Dermal Unit Exposure (mg/lb ai)[b]	Baseline Inhalation Unit Exposure (ug/lb ai)[c]	Maximum Application Rate (lb ai/acre)[d]	Crop[e]	Daily Acres Treated[f]	Baseline Dermal Dose (mg/kg/day)[g]	Baseline Inhalation Dose (mg/kg/day)[h]	Dermal MOE[i]	Inhalation MOE[j]	Total Short and Int-term MOE[k]
Mixing/Loading Liquids (EC formulation) for Groundboom Application (2d)	Study (45527601) 90th percentile	ND	ND	0.375	sugar beets	80	ND	ND	ND	ND	ND
				1.5	potato						
				0.5	Corn	200					
				1.0	Alfalfa						
Mixing/Loading Liquids (ME formulation) for Aerial/Chemigation Application (3a)	Study (45327101, 45513001) Median	ND	ND	0.5	Onion	350	ND	ND	ND	ND	ND
				1.0	corn						
				2.0	Walnut						
				1	corn	1200					
Mixing/Loading Liquids (ME formulation) for Aerial/Chemigation Application (3b)	Study (45327101, 45513001) 90th percentile	ND	ND	0.5	Onion	350	ND	ND	ND	ND	ND
				1.0	corn						
				2.0	Walnut						
				1	corn	1200					
Mixing/Loading Liquids (ME formulation) for Groundboom Application (3c)	Study (45327101, 45513001) Median	ND	ND	0.5	Onion	80	ND	ND	ND	ND	ND
				1.5	Potato						
				1	corn	200					
Mixing/Loading Liquids (ME formulation) for Groundboom Application (3d)	Study (45327101, 45513001) 90th percentile	ND	ND	0.5	Onion	80	ND	ND	ND	ND	ND
				1.5	Potato						
				1	corn	200					
Mixing/Loading Liquids (ME formulation) for Airblast Sprayer (3e)	Study (45327101, 45513001) Median	ND	ND	2	walnuts	40	ND	ND	ND	ND	ND
Mixing/Loading Liquids (ME formulation) for Airblast Sprayer (3f)	Study (45327101, 45513001) 90th percentile	ND	ND	2	walnuts	40	ND	ND	ND	ND	ND
Applicator Exposure											

Exposure Scenario (Scenario #)	Unit Exposure Data Source[a]	Baseline Dermal Unit Exposure (mg/lb ai)[b]	Baseline Inhalation Unit Exposure (ug/lb ai)[c]	Maximum Application Rate (lb ai/acre)[d]	Crop[e]	Daily Acres Treated[f]	Baseline Dermal Dose (mg/kg/day)[g]	Baseline Inhalation Dose (mg/kg/day)[h]	Dermal MOE[i]	Inhalation MOE[j]	Total Short and Int-term MOE[k]
Applying Liquids with Aerial Equipment (EC and ME formulations) (4)	PHED	See Eng. Controls	See Eng. Controls	0.375	sugar beets	350	See Eng. Controls	See Eng. Controls	See Eng. Controls	See Eng. Controls	See Eng. Controls
				1.0	Alfalfa						
				2.0	Walnut						
				0.5	Corn	1200					
				1.0	Alfalfa						
Applying Liquids with a Groundboom Sprayer (EC and ME formulations) (5)	PHED	0.014	0.74	0.375	sugar beets	80	0.0060	0.00030	17	350	16
				1.5	Potato		0.0240	0.0013	4	87	4
				0.5	Corn	200	0.0200	0.0011	5	100	5
				1.0	Alfalfa		0.0400	0.0021	3	52	2
Applying Liquids with a Groundboom Sprayer (ME formulation) (6a)	Study (45449001, 45502401) geometric mean	ND	ND	0.5	Onions	80	ND	ND	ND	ND	ND
				1.5	Potato						
				1.0	Corn	200					
Applying Liquids with a Groundboom Sprayer (ME formulation) (6b)	Study (45449001, 45502401) 90th percentile	ND	ND	0.5	Onions	80	ND	ND	ND	ND	ND
				1.5	Potato						
				1.0	Corn	200					
Applying Sprays with an Airblast Sprayer (ME formulation) (7)	PHED	0.36	4.5	2.0	Walnut	40	0.41	0.0051	0.24	21	0.24
Flagger Exposures											
Flagging Aerial Spray Applications (EC and ME formulations) (8)	PHED	0.011	0.35	0.375	sugar beets	350	0.021	0.0007	4.9	170	4.7
				1.0	Alfalfa		0.055	0.0018	1.8	63	1.8
				2.0	Walnut		0.110	0.0035	0.91	31	0.88

Footnotes

EC = emulsifiable concentrate formulation. ME = microencapsulate formulation.

ND = No data for this scenario for this data source.

a Unit exposure data source: PHED unit exposure data shown for all scenarios, either as the sole unit exposure data source or as a comparison to the unit exposure data determined from the studies. Unit exposure data from the studies shown for the average unit exposure value and the 90th percentile. See above study summaries and description of unit exposure calculations shown previously in this document for more information.

b Baseline dermal unit exposure represents long pants, long sleeved shirt, no gloves, open mixing/loading, open cab tractor. Baseline data are not available for aerial equipment.

c Baseline inhalation exposure represents no respirator.

d Application rates are a range of maximum application rates proposed by the registrant and on the labels. See list of crop specific application rates in the use section of this assessment for more information.

e Crops named are index crops which are chosen to represent all other crops at or near that application rate for that use. See the application rates listing in the use summary section of this document for further information on application rates used in this assessment. **Note:** For scenarios that represent both formulations (scenarios 1, 4, 5, and 8), some index crops may not exist for a formulation or maybe have a different application rate for that formulation. The assessment of the range of application rates that exists for a scenario is what is assessed, index crops are only for clarification.

f Daily amount treated are based on Science Advisory Council for Exposure Policy # 9.1.[11]

g Baseline dermal dose (mg/kg/day) = (Dermal Unit Exposure (mg/lb ai) * Application rate (lb ai/acre) * Acres treated (acres/day)) / Body weight (70 kg).

h Baseline inhalation dose (mg/kg/day) = (Inhalation Unit Exposure (:g/lb ai) * (1mg/1000 :g) Conversion factor * Application rate (lb ai/A) * Acres treated (acres/day))/ Body weight (70 kg).

i Dermal MOE = Dermal adjusted LOAEL (0.10 mg/kg/day)/Dermal Dose (mg/kg/day). (0.3 mg/kg/day divided by 3x)

j Inhalation MOE = Inhalation NOAEL (0.11 mg/kg/day)/ Daily Inhalation Dose (mg/kg/day).

k Total Short and Intermediate Term MOE =1/((1/dermal MOE)+(1/inhalation MOE))

Table **F. Occupational Short and Intermediate Term Combined Inhalation and Dermal MOEs for Methyl Parathion at the Additional PPE Level of Mitigation.**

Exposure Scenario (Scenario #)	Unit Exposure Data Source[a]	Maximum Application Rate (lb ai/acre)[b]	Crop[c]	Daily Acres Treated[d]	Unit Dermal Exposure[e] (mg/lb ai)	Daily Dermal Dose[f] (mg/kg/day)	Unit Inhalation Exposure[g] (µg/lb ai)	Daily Inhalation Dose[h] (mg/kg/day)	Dermal MOE[i]	Inhalation MOE[j]	Total MOE[k]
Mixer/Loader Exposure and Dose Levels											
Mixing/Loading Liquids (EC and ME formulations) for Aerial/Chemigation Application (1a)	PHED (liquid used as a surrogate for M/L the ME formulation)	0.375	sugar beets	350	0.017	0.032	0.24	0.00045	3	240	3
		1.0	Alfalfa			0.085		0.0012	1.2	92	1
		2.0	Walnut			0.17		0.0024	0.59	46	0.58
		0.5	Corn	1200		0.15		0.0021	0.69	53	0.68
		1.0	Alfalfa			0.29		0.0041	0.34	27	0.34
Mixing/Loading Liquids (EC and ME formulation) for Groundboom Application (1b)		0.375	sugar beets	80		0.007		0.00010	14	1100	14
		1.5	Potato			0.029		0.00041	3	270	3
		0.5	Corn	200		0.024		0.00034	4	320	4
		1.0	Alfalfa			0.049		0.00069	2	160	2
Mixing/Loading Liquids (ME formulation) for Airblast Sprayer (1c)		2.0	Walnut	40		0.019		0.00027	5	400	5
Mixing/Loading Liquids (EC formulations) for Aerial Application (2a)	Study (45527601) median	0.375	sugar beets	350	ND	ND	ND	ND	ND	ND	ND
		1.5	Potato								
		0.5	Corn	1200							
		1.0	Alfalfa								
Mixing/Loading Liquids (EC formulation) for Aerial Application (2b)	Study (45527601) 90th percentile	0.375	sugar beets	350	ND	ND	ND	ND	ND	ND	ND
		1.5	potato								
		0.5	Corn	1200							
		1.0	Alfalfa								
Mixing/Loading Liquids (EC formulations) for Groundboom Application (2c)	Study (45527601) median	0.375	sugar beets	80	ND	ND	ND	ND	ND	ND	ND
		1.5	potato								
		0.5	Corn	200							
		1.0	Alfalfa								
Mixing/Loading Liquids (EC formulation) for Groundboom Application (2d)	Study (45527601) 90th percentile	0.375	sugar beets	80	ND	ND	ND	ND	ND	ND	ND
		1.5	potato								
		0.5	Corn	200							
		1.0	Alfalfa								

Table **F. Occupational Short and Intermediate Term Combined Inhalation and Dermal MOEs for Methyl Parathion at the Additional PPE Level of Mitigation.**

Exposure Scenario (Scenario #)	Unit Exposure Data Source[a]	Maximum Application Rate (lb ai/acre)[b]	Crop[c]	Daily Acres Treated[d]	Unit Dermal Exposure[e] (mg/lb ai)	Daily Dermal Dose[f] (mg/kg/day)	Unit Inhalation Exposure[g] (µg/lb ai)	Daily Inhalation Dose[h] (mg/kg/day)	Dermal MOE[i]	Inhalation MOE[j]	Total MOE[k]
Mixing/Loading Liquids (ME formulation) for Aerial/Chemigation Application (3a)	Study (45327101, 45513001) Median	0.5	Onion	350	0.000201 (total)	0.0005	see dermal	see dermal	200	see dermal	200
		1.0	corn			0.0010			100		100
		2.0	Walnut			0.0020			50		50
		1	corn	1200		0.0034			29		29
Mixing/Loading Liquids (ME formulation) for Aerial/Chemigation Application (3b)	Study (45327101, 45513001) 90th percentile	0.5	Onion	350	0.000882 (total)	0.0022	see dermal	see dermal	45	see dermal	45
		1.0	corn			0.0044			23		23
		2.0	Walnut			0.0088			11		11
		1	corn	1200		0.015			7		7
Mixing/Loading Liquids (ME formulation) for Groundboom Application (3c)	Study (45327101, 45513001) Median	0.5	Onion	80	0.000201 (total)	0.0001	see dermal	see dermal	870	see dermal	870
		1.5	Potato			0.0003			290		290
		1	corn	200		0.0006			170		170
Mixing/Loading Liquids (ME formulation) for Groundboom Application (3d)	Study (45327101, 45513001) 90th percentile	0.5	Onion	80	0.000882 (total)	0.0005	see dermal	see dermal	200	see dermal	200
		1.5	Potato			0.0015			66		66
		1	corn	200		0.0025			40		40
Mixing/Loading Liquids (ME formulation) for Airblast Sprayer (3e)	Study (45327101, 45513001) Median	2	walnuts	40	0.000201 (total)	0.0002	see dermal	see dermal	440	see dermal	440
Mixing/Loading Liquids (ME formulation) for Airblast Sprayer (3f)	Study (45327101, 45513001) 90th percentile	2	walnuts	40	0.000882 (total)	0.0010	see dermal	see dermal	100	see dermal	99

Table **F. Occupational Short and Intermediate Term Combined Inhalation and Dermal MOEs for Methyl Parathion at the Additional PPE Level of Mitigation.**

Exposure Scenario (Scenario #)	Unit Exposure Data Source[a]	Maximum Application Rate (lb ai/acre)[b]	Crop[c]	Daily Acres Treated[d]	Unit Dermal Exposure[e] (mg/lb ai)	Daily Dermal Dose[f] (mg/kg/day)	Unit Inhalation Exposure[g] (µg/lb ai)	Daily Inhalation Dose[h] (mg/kg/day)	Dermal MOE[i]	Inhalation MOE[j]	Total MOE[k]
Applicator Exposure											
Applying Liquids with Aerial Equipment (EC and ME formulations) (4)	PHED	0.375	sugar beets	350	See Eng. Controls	See Eng. Controls	See Eng. Controls	See Eng. Controls	See Eng. Controls	See Eng. Controls	See Eng. Controls
		1.0	Alfalfa								
		2.0	Walnut								
		0.5	Corn	1200							
		1.0	Alfalfa								
Applying Liquids with a Groundboom Sprayer (EC and ME formulations) (5)	PHED	0.375	sugar beets	80	0.011	0.0047	0.15	0.00006	21	1700	21
		1.5	Potato			0.019		0.00026	5	430	5
		0.5	Corn	200		0.016		0.00021	6	510	6
		1.0	Alfalfa			0.031		0.00043	3	260	3
Applying Liquids with a Groundboom Sprayer (ME formulation) (6a)	Study (45449001, 45502401) geometric mean	0.5	Onions	80	0.000468 (total)	0.0003	see dermal	see dermal	370	see dermal	370
		1.5	Potato			0.0008			130		130
		1.0	Corn	200		0.0013			75		75
Applying Liquids with a Groundboom Sprayer (ME formulation) (6b)	Study (45449001, 45502401) 90th percentile	0.5	Onions	80	0.00186 (total)	0.0011	see dermal	see dermal	94	see dermal	94
		1.5	Potato			0.0032			31		31
		1.0	Corn	200		0.0053			19		19
Applying Sprays with an Airblast Sprayer (ME formulation) (7)	PHED	2.0	Walnut	40	0.22	0.25	0.90	0.00103	0.40	110	0.40
Flagger Exposure											
Flagging Aerial Spray Applications (EC and ME formulations) (8)	PHED	0.375	sugar beets	350	0.010	0.019	0.070	0.00013	5	840	5
		1.0	Alfalfa			0.050		0.00035	2	310	2
		2.0	Walnut			0.10		0.00070	1	160	0.99

Footnotes

EC = emulsifiable concentrate formulation. ME = microencapsulate formulation.

ND = No data for this scenario for this data source.

a Unit exposure data source: PHED unit exposure data shown for all scenarios, either as the sole unit exposure data source or as a comparison to the unit exposure data determined from the studies. Unit exposure data from the studies shown for the average unit exposure value and the 90^{th} percentile. See above study summaries and description of unit exposure calculations shown previously in this document for more information.

b Application rates are a range of maximum application rates proposed by the registrant and on the labels. See list of crop specific application rates in the use section of this assessment for more information.

c Crops named are index crops which are chosen to represent all other crops at or near that application rate for that use. See the application rates listing in the use summary section of this document for further information on application rates used in this assessment. **Note:** For scenarios that represent both formulations (scenarios 1, 4, 5, and 8), some index crops may not exist for a formulation or maybe have a different application rate for that formulation. The assessment of the range of application rates that exists for a scenario is what is assessed, index crops are only for clarification.

d Daily amount treated are based on Science Advisory Council for Exposure Policy # 9.1.[11]

e Dermal unit exposure represents long pants, long sleeved shirt, coveralls, gloves, open mixing/loading, open cab tractor.

Note: Unit exposure data determined from studies are TOTAL unit exposures, and are listed under the dermal unit exposure column and noted as total unit exposures (dermal + inhalation).

f Dermal dose (mg/kg/day) = (Dermal Unit Exposure (mg/lb ai) * Application rate (lb ai/acre) * Acres treated (acres/day)) / Body weight (70 kg).

g Inhalation exposure represents dust/mist respirator.

h Inhalation dose (mg/kg/day) = (Inhalation Unit Exposure (:g/lb ai) * (1mg/1000 :g) Conversion factor * Application rate (lb ai/A) * Acres treated (acres/day))/ Body weight (70 kg).

i Dermal MOE = Dermal adjusted LOAEL (0.10 mg/kg/day)/Dermal Dose (mg/kg/day). (0.3 mg/kg/day divided by 3x)

j Inhalation MOE = Inhalation NOAEL (0.11 mg/kg/day)/ Daily Inhalation Dose (mg/kg/day).

k Total Short and Intermediate Term MOE =1/((1/dermal MOE)+(1/inhalation MOE))

Table **G. Occupational Short and Intermediate Term Combined Inhalation and Dermal MOEs for Methyl Parathion at the Engineering Control Level of Mitigation.**

Exposure Scenario (Scenario #)	Unit Exposure Data Source[a]	Maximum Application Rate (lb ai/acre)[b]	Crop[c]	Daily Acres Treated[d]	Unit Dermal Exposure[e] (mg/lb ai)	Daily Dermal Dose[f] (mg/kg/day)	Unit Inhalation Exposure[e] (µg/lb ai)	Daily Inhalation Dose[g] (mg/kg/day)	Dermal MOE[h]	Inhalation MOE[i]	Total MOE[j]
Mixer/Loader Exposure											
Mixing/Loading Liquids (EC and ME formulations) for Aerial/Chemigation Application (1a)	PHED (liquid used as a surrogate for M/L the ME formulation)	0.375	sugar beets	350	0.0086 (gloves)	0.016	0.083	0.00016	6	710	6
		1.0	Alfalfa			0.043		0.00042	2	270	2
		2.0	Walnut			0.086		0.00083	1	130	1
		0.5	Corn	1200		0.074		0.00071	1	160	1
		1.0	Alfalfa			0.147		0.0014	1	77	1
Mixing/Loading Liquids (EC and ME formulation) for Groundboom Application (1b)		0.375	sugar beets	80		0.0037		0.00004	27	3100	27
		1.5	Potato			0.015		0.00014	7	770	7
		0.5	Corn	200		0.012		0.00012	8	930	8
		1.0	Alfalfa			0.025		0.00024	4	460	4
Mixing/Loading Liquids (ME formulation) for Airblast Sprayer (1c)		2.0	Walnut	40		0.0098		0.000090	10	1200	10
Mixing/Loading Liquids (EC formulations) for Aerial Application (2a)	Study (45527601) median	0.375	sugar beets	350	0.000030 (total)	0.00006	see dermal	see dermal	1800	see dermal	1800
		1.5	Potato			0.00023			440		440
		0.5	Corn	1200		0.00026			390		390
		1.0	Alfalfa			0.00051			190		190
Mixing/Loading Liquids (EC formulation) for Aerial Application (2b)	Study (45527601) 90th percentile	0.375	sugar beets	350	0.00015 (total)	0.00028	see dermal	see dermal	350	see dermal	350
		1.5	potato			0.0011			88		88
		0.5	Corn	1200		0.0013			77		77
		1.0	Alfalfa			0.0026			39		39
Mixing/Loading Liquids (EC formulations) for Groundboom Application (2c)	Study (45527601) median	0.375	sugar beets	80	0.000030 (total)	0.00001	see dermal	see dermal	7800	see dermal	7800
		1.5	potato			0.00005			1900		1900
		0.5	Corn	200		0.00004			2300		2300
		1.0	Alfalfa			0.00009			1200		1200
Mixing/Loading Liquids (EC formulation) for Groundboom Application (2d)	Study (45527601) 90th percentile	0.375	sugar beets	80	0.00015 (total)	0.00006	see dermal	see dermal	1500	see dermal	1500
		1.5	potato			0.00026			390		390
		0.5	Corn	200		0.00022			460		460
		1.0	Alfalfa			0.00043			230		230

Table **G. Occupational Short and Intermediate Term Combined Inhalation and Dermal MOEs for Methyl Parathion at the Engineering Control Level of Mitigation.**

Exposure Scenario (Scenario #)	Unit Exposure Data Source[a]	Maximum Application Rate (lb ai/acre)[b]	Crop[c]	Daily Acres Treated[d]	Unit Dermal Exposure[e] (mg/lb ai)	Daily Dermal Dose[f] (mg/kg/day)	Unit Inhalation Exposure[e] (µg/lb ai)	Daily Inhalation Dose[g] (mg/kg/day)	Dermal MOE[h]	Inhalation MOE[i]	Total MOE[j]
Mixing/Loading Liquids (ME formulation) for Aerial/Chemigation Application (3a)	Study (45327101, 45513001) Median	0.5	Onion	350	ND	ND	ND	ND	ND	ND	ND
		1.0	corn								
		2.0	Walnut								
		1	corn	1200							
Mixing/Loading Liquids (ME formulation) for Aerial/Chemigation Application (3b)	Study (45327101, 45513001) 90th percentile	0.5	Onion	350	ND	ND	ND	ND	ND	ND	ND
		1.0	corn								
		2.0	Walnut								
		1	corn	1200							
Mixing/Loading Liquids (ME formulation) for Groundboom Application (3c)	Study (45327101, 45513001) Median	0.5	Onion	80	ND	ND	ND	ND	ND	ND	ND
		1.5	Potato								
		1	corn	200							
Mixing/Loading Liquids (ME formulation) for Groundboom Application (3d)	Study (45327101, 45513001) 90th percentile	0.5	Onion	80	ND	ND	ND	ND	ND	ND	ND
		1.5	Potato								
		1	corn	200							
Mixing/Loading Liquids (ME formulation) for Airblast Sprayer (3e)	Study (45327101, 45513001) Median	2	walnuts	40	ND	ND	ND	ND	ND	ND	ND
Mixing/Loading Liquids (ME formulation) for Airblast Sprayer (3f)	Study (45327101, 45513001) 90th percentile	2	walnuts	40	ND	ND	ND	ND	ND	ND	ND
Applicator Exposure											
Applying Liquids with Aerial Equipment (EC and ME formulations) (4)	PHED	0.375	sugar beets	350	0.0050	0.0094	0.068	0.00013	11	860	11
		1.0	Alfalfa			0.025		0.00034	4	320	4
		2.0	Walnut			0.05		0.00068	2	160	2
		0.5	Corn	1200		0.043		0.00058	2	190	2
		1.0	Alfalfa			0.086		0.0012	1	94	1

Table **G. Occupational Short and Intermediate Term Combined Inhalation and Dermal MOEs for Methyl Parathion at the Engineering Control Level of Mitigation.**

Exposure Scenario (Scenario #)	Unit Exposure Data Source[a]	Maximum Application Rate (lb ai/acre)[b]	Crop[c]	Daily Acres Treated[d]	Unit Dermal Exposure[e] (mg/lb ai)	Daily Dermal Dose[f] (mg/kg/day)	Unit Inhalation Exposure[e] (µg/lb ai)	Daily Inhalation Dose[g] (mg/kg/day)	Dermal MOE[h]	Inhalation MOE[i]	Total MOE[j]
Applying Liquids with a Groundboom Sprayer (EC and ME formulations) (5)	PHED	0.375	sugar beets	80	0.0050	0.0021	0.043	0.00002	47	6000	46
		1.5	Potato			0.0086		0.00007	12	1500	12
		0.5	Corn	200		0.0071		0.00006	14	1800	14
		1.0	Alfalfa			0.014		0.00012	7	900	7
Applying Liquids with a Groundboom Sprayer (ME formulation) (6a)	Study (45449001, 45502401) geometric mean	0.5	Onions	80	ND	ND	ND	ND	ND	ND	ND
		1.5	Potato								
		1.0	Corn	200							
Applying Liquids with a Groundboom Sprayer (ME formulation) (6b)	Study (45449001, 45502401) 90th percentile	0.5	Onions	80	ND	ND	ND	ND	ND	ND	ND
		1.5	Potato								
		1.0	Corn	200							
Applying Sprays with an Airblast Sprayer (ME formulation) (7)	PHED	2.0	Walnut	40	0.019 (gloves)	0.022	0.45	0.00051	5	210	5
Flagger Exposure											
Flagging Aerial Spray Applications (EC and ME formulations) (8)	PHED	0.375	sugar beets	350	0.00022	0.00041	0.007	0.00001	240	8400	240
		1.0	Alfalfa			0.0011		0.00004	91	3100	88
		2.0	Walnut			0.0022		0.00007	45	1600	44

Footnotes

EC = emulsifiable concentrate formulation. ME = microencapsulate formulation.

ND = No data for this scenario for this data source.

a Unit exposure data source: PHED unit exposure data shown for all scenarios, either as the sole unit exposure data source or as a comparison to the unit exposure data determined from the studies. Unit exposure data from the studies shown for the average unit exposure value and the 90th percentile. See above study summaries and description of unit exposure calculations shown previously in this document for more information.

b Application rates are a range of maximum application rates proposed by the registrant and on the labels. See list of crop specific application rates in the use section of this assessment for more information.

c Crops named are index crops which are chosen to represent all other crops at or near that application rate for that use. See the application rates listing in the use summary section of this document for further information on application rates used in this assessment. **Note:** For scenarios that represent both formulations (scenarios 1, 4, 5, and 8), some index crops may not exist for a formulation or maybe have a different application rate for that formulation. The assessment of the range of application rates that exists for a scenario is what is assessed, index crops are only for clarification.

d Daily amount treated are based on Science Advisory Council for Exposure Policy # 9.1.[11]

e

Scenario Number	Engineering Controls
1/3	Closed mixing / loading, single layer clothing, chemical resistant gloves.
2	Micromatic "DV" liquid transfer system
4, 5, 6, 7	Enclosed cab, single layer clothing, no gloves.
8	Enclosed truck (98% Protection Factor), single layer clothing, no gloves.

Note: Unit exposure data determined from studies are TOTAL unit exposures, and are listed under the dermal unit exposure column and noted as total unit exposures (dermal + inhalation).

f Dermal dose (mg/kg/day) = (Dermal Unit Exposure (mg/lb ai) * Application rate (lb ai/acre) * Acres treated (acres/day)) / Body weight (70 kg).

g Inhalation dose (mg/kg/day) = (Inhalation Unit Exposure (:g/lb ai) * (1mg/1000 :g) Conversion factor * Application rate (lb ai/A) * Acres treated (acres/day))/ Body weight (70 kg).

h Dermal MOE = Dermal adjusted LOAEL (0.10 mg/kg/day)/Dermal Dose (mg/kg/day). (0.3 mg/kg/day divided by 3x)

i Inhalation MOE = Inhalation NOAEL (0.11 mg/kg/day)/ Daily Inhalation Dose (mg/kg/day).

j Total Short and Intermediate Term MOE =1/((1/dermal MOE)+(1/inhalation MOE))

Table H: Occupational Exposure Scenario Descriptions for the Use of Methyl Parathion

Exposure Scenario (Number)	Data Source	Standard Values[a] (8-hr work day)	Comments[b]
Mixer/Loader Exposure			
Mixing/Loading Liquids (EC and ME formulations) (1a/b/c)	PHED V1.1	350 acres for aerial and chemigation; 1200 acres for aerial for alfalfa, barley, corn, cotton, oats, rice, rye, soybeans, and wheat; 80 acres for groundboom; 200 acres for groundboom for alfalfa, barley, corn, cotton, oats, rice, rye, soybeans, and wheat; and 40 acres for airblast.	**Baseline:** Hands, dermal, and inhalation AB grades. Dermal = 72 to 122 replicates; hands = 53 replicates; and inhalation= 85 replicates. High confidence in all data. **PPE:** Hands, dermal, and inhalation AB grades. Dermal = 72 to 122 replicates; hands = 59 replicates; and inhalation= 85 replicates. High confidence in all data. **Engineering Controls:** Hands, dermal, and inhalation AB grades; Dermal = 16 to 22 replicates; hands = 31 replicates; and inhalation = 27 replicates. High confidence in all data. A 50% PF was added to simulate coveralls for PPE. An 80% PF was used for PPE for inhalation to represent a dust/mist respirator. Engineering Controls data were monitored with chemical resistant gloves. No PHED data was available for microencapsulate formulations; therefore, PHED for liquids was used as a surrogate.
Mixing/Loading Liquids (EC formulations) (2a/b/c/d)	Study (MRID # 45527601)	350 acres for aerial; 1200 acres for aerial for alfalfa, barley, corn, cotton, oats, rice, rye, soybeans, and wheat; 80 acres for groundboom; and 200 acres for groundboom for alfalfa, barley, corn, cotton, oats, rice, rye, soybeans, and wheat.	**Baseline:** No data **PPE:** No data **Engineering Controls:** 16 replicates. Biomonitoring data measures exposures from all routes, dermal, hands and inhalation. High confidence in all data. PPE worn: coveralls over long-sleeved shirt and long pants, chemical resistant gloves, chemical resistant footwear and socks, protective eye wear, chemical-resistant apron; and dust/mist filtering half-face respirator.

Exposure Scenario (Number)	Data Source	Standard Values[a] (8-hr work day)	Comments[b]
Mixing/Loading Liquids (ME formulation) (3a/b/c/d/e/f)	Study (MRID # 45327101, 45513001)	350 acres for aerial and chemigation; 1200 acres for aerial for barley, corn, cotton, oats, rice, soybeans, wheat; 80 acres for groundboom; 200 acres for groundboom for alfalfa, barley, corn, cotton, oats, rice, rye, soybeans, wheat; and 40 acres for airblast.	**Baseline:** No data **PPE:** 26 replicates. Biomonitoring data measures exposures from all routes, dermal, hands and inhalation. High confidence in all data. PPE worn: long-sleeved shirt and long pants underneath coveralls, socks and rubber boots, protective gloves, plastic goggles, and dust/mist filtering respirator. At the Harquahala Valley, Arizona site in study 45327101 (5 replicates), test subjects wore the same PPE as previously listed with the following modifications: nitrile, instead of neoprene, protective gloves, face shield, instead of goggles, chemical resistant apron, and Tyvek® rain type hat. The unit exposure values from the replicates wearing the additional PPE were not substantially different than the ones without, and in some cases they were higher. Therefore, all of the replicates from both studies were combined, assuming that the extra PPE (headgear, aprons) resulted in no quantitative difference in the unit exposure numbers from these two studies. **Engineering Controls:** No data.
Applicator Exposure			
Applying Liquids with Aerial Equipment (EC and ME formulations) (4)	PHED V1.1	350 acres for aerial; 1200 acres for aerial for alfalfa, barley, corn, cotton, oats, rice, rye, soybeans, and wheat.	**Engineering controls:** Dermal and inhalation = ABC grades; and hands = AB grades. Dermal = 24 to 48 replicates; hands = 34 replicates; and inhalation = 23 replicates. Medium confidence in all data.
Applying Liquids with a Groundboom Sprayer (EC and ME formulations) (5)	PHED V1.1	80 acres for groundboom; and 200 acres for groundboom for alfalfa, barley, corn, cotton, oats, rice, rye, soybeans, and wheat.	**Baseline:** Hands and dermal, and inhalation = AB grades. Dermal = 23 to 42 replicates; hands = 29 replicates; and inhalation = 22 replicates. High confidence in all data. **PPE:** Hands = ABC grades. dermal, and inhalation = AB grades. Dermal = 23 to 42 replicates; hands = 21 replicates; and inhalation = 22 replicates. High confidence dermal and inhalation data, medium confidence in hand data. **Engineering Controls:** Dermal and hands = ABC grades. Dermal = 20 to 31 replicates; hands = 16 replicates. Medium confidence in dermal and hands data. Inhalation AB grades, 16 replicates; High confidence in inhalation data. A 50% PF was added to the PPE scenario only to simulate coveralls. An 80% PF was used for PPE for inhalation to represent a dust/mist respirator.

Exposure Scenario (Number)	Data Source	Standard Values[a] (8-hr work day)	Comments[b]
Applying Liquids with a Groundboom Sprayer (ME formulation) (6a/b)	Study (MRID # 45449001, 45502401)	80 acres for groundboom; and 200 acres for groundboom for barley, corn, cotton, oats, rice, soybeans, and wheat.	**Baseline:** No data **PPE:** 15 replicates. Biomonitoring data measures exposures from all routes, dermal, hands and inhalation. High confidence in all data. PPE worn: coveralls over long-sleeved shirt and long pants, chemical resistant gloves, socks, and footwear, protective eye wear, chemical-headgear for overhead exposure; and dust/mist filtering half-face respirator **Engineering Controls:** No data.
Applying Liquids (ME formulation) with an Airblast Sprayer (7)	PHED V1.1	40 acres	**Baseline:** Hands, dermal, and inhalation = AB grades. Dermal = 32 to 49 replicates; hands = 22 replicates; and inhalation = 47 replicates. High confidence in all data. **PPE:** Hands, dermal, and inhalation = AB grades. Dermal = 32 to 49 replicates; hands = 18 replicates; and inhalation = 47 replicates. High confidence in all data. **Engineering Controls:** Hands and dermal = AB grades; and inhalation= ABC grades. Dermal = 20 to 30 replicates; hands = 20 replicates; and inhalation = 9 replicates. High confidence in dermal and hand data. Low confidence in inhalation data. A 50 percent PF was used for PPE to simulate coveralls. An 80% PF for the addition of a dust/mist respirator. Engineering Controls data were monitored with chemical resistant gloves.
Flagger Exposure			
Flagging Aerial Spray (ME and EC formulations) Applications (8)	PHED V1.1	350 acres	**Baseline:** Hands, dermal, and inhalation = ABC grades. Hands = 30 replicates; dermal = 18 to 28 replicates; and inhalation = 28 replicates. High confidence in dermal, hands, and inhalation data. **PPE:** Hands, dermal, and inhalation = AB grades. Hands = 6 replicates; dermal = 18 to 28 replicates; and inhalation = 28 replicates. High confidence in dermal and inhalation data. Low confidence in hand data. **Engineering Controls:** Same as baseline. A 50% PF was added for PPE to represent coveralls. 80% PF for addition of a dust/mist respirator. A 98 percent PF was applied to baseline to simulate engineering controls.

Footnotes

a Daily amount treated are based on Science Advisory Council for Exposure Policy # 9.1.[11]

b "Best Available" grades are defined by EPA SOP for meeting Series 875 Guidelines. Acceptable grades are matrices with grades A and B data. Data confidence are assigned as follows:

High = grades A and B and 15 or more replicates

Medium	= grades A, B, and C and 15 or more replicates
Low	= grades A, B, C, D, and E or any combination of grades with less than 15 replicates