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

**OFFICE OF CHEMICAL SAFETY AND POLLUTION PREVENTION**

**MEMORANDUM**

**Date**: April 10, 2020

**Subject:** **MCPB.** Revised Occupational and Residential Exposure Assessment for the Existing Uses of MCPB for Registration Review.

**PC Code:** 019201
**Decision No.:** 561594
**Petition No.:** NA
**Risk Assessment Type:** Occupational/Residential Exposure Assessment
**TXR No.:** NA
**MRID No.:** NA

**DP Barcode:** D457318
**Registration No.:** 7138-5, 15440-38
**Regulatory Action:** Registration Review
**Case No.:** 2365
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**40 CFR:** §180.318

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## Introduction

The Health Effects Division (HED) of the Office of Pesticide Programs (OPP) is charged with estimating the risk to human health from exposure to pesticides. As part of Registration Review, the Pesticide Re-evaluation Division (PRD) of OPP has requested that HED conduct an occupational and residential exposure assessment, as needed, to estimate the risk to human health that will result from the currently registered uses of MCPB [4-(4-chloro-o-tolyoxy)*butanoic* acid] in support of registration review.

This memo supersedes the previous memo (D450515, U. Hassan, 06/10/2019). This revised memo incorporates changes to the spray drift assessment, occupational handler assessment, and occupational post-application assessment based on a decrease of the dermal absorption factor (DAF) from 86% to 7.8%. In addition, the spray drift assessment was updated to incorporate available MCPA-specific turf transferable residue (TTR) data in place of default TTR assumptions (MRID 44655702). This revised memo also clarifies errors related to the acute dermal toxicity category.

It is HED policy to use the best available data to assess exposure. Several sources of generic data were used in this assessment as surrogate data in the absence of chemical-specific data, including Pesticide Handlers Exposure Database Version 1.1 (PHED 1.1); the Agricultural Handler Exposure Task Force (AHETF) database; and the Agricultural Reentry Task Force (ARTF) database. Some of these data are proprietary, and subject to the data protection provisions of the Federal Insecticide, Fungicide, and Rodenticide Act (FIFRA).

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## 1.0 Executive Summary

HED has conducted a revised occupational and residential exposure assessment for Registration Review of the registered uses of the active ingredient (ai), MCPB [4-(4-chloro-o-tolyoxy) *butanoic* acid]. It is currently registered for pre- and post-emergence selective weed control to protect mint and pea crops from a variety of weeds including Canadian thistle, common lambs quarters, pigweed, smartweed, sowthistle, and morning glories. This memo supersedes the previous memo (D450515, U. Hassan, 06/10/2019).

This memorandum contains HED's occupational handler and post-application exposure and risk estimates. In addition, an assessment of non-occupational exposures resulting from spray drift was conducted. There are no currently registered residential uses associated with MCPB; therefore, a quantitative assessment of residential exposure was not conducted.

Use Profile

MCPB is used for pre-bloom and post-emergence selective weed control in pea and mint. The registered products are liquid/soluble concentrate (SC) formulations and the maximum application rate is 1.5 lb acid equivalents (ae)/acre on peas and is 0.5 lb ae/acre on mint. MCPB can be applied as a broadcast application by aerial or by ground equipment. There are no residential uses of MCPB.

Exposure Profile

There are no currently registered residential uses of MCPB; therefore, a quantitative assessment of residential exposure was not conducted. However, there is the potential for non-occupational exposures from spray drift (dermal and/or incidental oral) which are expected to be short-term only. For occupational use patterns, short-and intermediate-term dermal and inhalation exposures are anticipated for occupational handlers and short- and intermediate-term dermal exposures for post-application workers. Registered labels require mixer/loaders, applicators, and other handlers to wear baseline clothing (i.e., long sleeved shirt and long pants, shoes and socks) and chemical resistant gloves. Labels include restricted entry intervals (REIs) of 12 and 24 hours.

Hazard Characterization

The toxicology database on MCPB is complete and sufficient for assessing the toxicity and characterizing the hazard of MCPB in acid equivalence. A no observed adverse effect level (NOAEL) of 7.5 mg/kg/day was selected for the short- and intermediate-term dermal and short-term incidental oral points of departure (PODs) based on decreased pup weights during lactation at the lowest observed adverse effect level (LOAEL) of 22.5 mg/kg/day in the two-generation reproduction toxicity study. The DAF has been reduced to 7.8% since the previous assessment. The Food Quality Protection Act (FQPA) Safety Factor (SF) of 10X was reduced to 1X. The level of concern (LOC) is 100 [10X to account for interspecies extrapolation, 10X for intra-species variation, and 1X FQPA SF].

Short- and intermediate-term inhalation endpoints were selected from the route-specific MCPB 28-day inhalation toxicity study in rats with a no observed adverse effect concentration (NOAEC) of 0.05 mg/L. Observed squamous metaplasia of the laryngeal respiratory epithelium and hyperplasia and inflammation of the anterior larynx (Level I) and mid larynx (Level II) were noted at the lowest adverse effect concentration (LOAEC) of 0.20 mg/L. Human Equivalent Concentrations (HECs)/Human Equivalent Doses (HEDs) were calculated. The LOC is 30 [(10X to account for interspecies extrapolation, 3X to account for inter-speciation variation (for pharmacodynamic (PD) differences)].

MCPB is classified as "not likely to be a human carcinogen" based on the lack of evidence of carcinogenicity in mice and rats following exposure to MCPB, and there is no concern for mutagenicity.

The MCPB risk assessments are based on the most sensitive endpoints in the toxicity database for MCPB and MCPA, and the points of departure (PODs) selected for risk assessment are considered protective of any potential adverse effects, including developmental, reproductive, and neurotoxic effects for infants and children.

Residential Exposure and Risk Assessment

There are no currently registered residential uses associated with MCPB; therefore, a quantitative assessment of residential exposure was not conducted.

Non-Occupational Spray Drift Exposure

A quantitative dermal and incidental oral spray drift assessment was conducted for MCPB, using available turf transferable residue (TTR) data translated from MCPA. MCPA is a structurally similar chlorophenoxy herbicide and differs slightly from MCPB which contains two additional carbon atoms. Metabolic enzymes typically remove carbons two at a time during degradation, in a process called β-oxidation. This results in MCPB being converted to MCPA. Adult dermal risk estimates from indirect exposure to MCPB related to spray drift are not of concern (i.e., MOEs ≥ 100) at the field edge for groundboom applications and aerial applications for mint or peas.

Dermal and incidental oral risk estimates were combined for children (1 to <2 years old) because the toxicity endpoint for each route of exposure is based on decreased pup weights during lactation in a two-generation reproduction study. The total applicable LOC is 100 so MOEs < 100 would be of concern. Children's (1 to <2 years old) dermal and incidental oral risk estimates from indirect exposure to MCPB related to spray drift result are not of concern at field edge for groundboom applications and aerial applications for mint and peas.

Occupational Exposure and Risk Assessment

There were no dermal risk estimates of concern for MCPB at baseline (i.e. single layer of clothing with gloves); all MOEs were ≥ the LOC of 100. There were no inhalation risk estimates of concern for MCPB at baseline (i.e., no respirator); all MOEs were ≥ the LOC of 30. All occupational post-application dermal risk estimates (based on MCPB-specific dislodgeable foliar residue (DFR) data) are not of concern (MOE ≥ 100, LOC = 100). Based on the Agency's current practices, a quantitative non-cancer occupational post-application inhalation exposure assessment was not performed for MCPB at this time. If new policies or procedures are put into place, the Agency may revisit the need for a quantitative occupational post-application inhalation exposure assessment for MCPB.

MCPB is classified as Toxicity Category III via the dermal route and Toxicity Category IV for skin irritation potential. This corrects the previous memo that stated that MCPB was classified as Toxicity Category II via the dermal route. It is not a skin sensitizer. Short- and intermediate-term post-application risk estimates were not a concern on day 0 (12 hours following application) for all post-application activities. Under 40 CFR 156.208 (c) (2), ai's classified as Acute III or IV for acute dermal, eye irritation and primary skin irritation are assigned a 12-hour REI. Therefore, the [156 subpart K] Worker Protection Statement interim REI of 12 hours is adequate to protect agricultural workers from post-application exposures to MCPB. HED would recommend a REI of 12 hours.

Human Studies Review

This risk assessment relies in part on data from studies in which adult human subjects were intentionally exposed to a pesticide or other chemical. These data, which include studies from PHED 1.1; the AHETF database; and the ARTF database; are (1) subject to ethics review pursuant to 40 CFR 26, (2) have received that review, and (3) are compliant with applicable ethics requirements. For certain studies, the ethics review may have included review by the Human Studies Review Board. Descriptions of data sources, as well as guidance on their use, can be found at the Agency website[1].

## 2.0 Risk Assessment Conclusions and Recommendations

### 2.1 Summary of Risk Estimates

There are no currently registered residential uses associated with MCPB; therefore, a quantitative assessment of residential exposure was not conducted.

Adult dermal risk estimates from indirect exposure to MCPB related to spray drift are not of concern at the field edge for groundboom applications and aerial applications. Children's (1 to <2 years old) combined dermal and incidental oral risk estimates from indirect exposure to MCPB related to spray drift are not of concern at the field edge for groundboom applications and aerial applications.

There were no occupational dermal or inhalation risk estimates of concern for MCPB at baseline (i.e., no respirator, single layer of clothing with gloves). All occupational post-application dermal risk estimates are not of concern. Based on the Agency's current practices, a quantitative non-cancer occupational post-application inhalation exposure assessment was not performed for MCPB at this time. If new policies or procedures are put into place, the Agency may revisit the need for a quantitative occupational post-application inhalation exposure assessment for MCPB.

### 2.2 Label Recommendations

No label recommendations.

[1] https://www.epa.gov/pesticide-science-and-assessing-pesticide-risks/occupational-pesticide-handler-exposure-data and https://www.epa.gov/pesticide-science-and-assessing-pesticide-risks/occupational-pesticide-post-application-exposure

## 2.3 Data Deficiencies and Requirements

No additional data are required.

## 3.0 Hazard Characterization

Acute Toxicity

A summary of the acute toxicity categories is included in Table 3.1. MCPB has been classified as Toxicity Category III for acute dermal toxicity and toxicity category II for acute eye irritation. MCPB is classified as Acute Toxicity Category IV for primary skin irritation.

**Table 3.1. Acute Toxicity Profile - MCPB Technical.**

| Guideline No. | Study Type | MRID(s) | Results | Toxicity Category |
|---|---|---|---|---|
| 870.1100 | Acute Oral (rat) | 00116340<br>100% a.i. | $LD_{50}$ = 1570 mg/kg (M)<br>$LD_{50}$ = 1700 mg/kg (F) | III |
| | | 00144801<br>97% a.i. | $LD_{50}$ = 4300 mg/kg (M)<br>$LD_{50}$ = 5300 mg/kg (F)<br>$LD_{50}$ = 4700 mg/kg (F) | III |
| 870.1200 | Acute Dermal (rat) | 00144799<br>97% a.i. | $LD_{50}$ > 2000 mg/kg (M & F) | III |
| | Acute Dermal (rabbit) | 00116342<br>100% a.i. | $LD_{50}$ > 10,000 mg/kg (M & F) | IV |
| 870.1300 | Acute Inhalation (rat) | 41630001<br>97% a.i. | $LC_{50}$ > 1.14 mg/L (M & F) | III |
| 870.2400 | Primary Eye Irritation (rabbit) | 00116343<br>100% a.i. | Moderately irritating | II |
| | | 00144797<br>97% a.i. | Mildly irritating | III |
| 870.2500 | Primary Skin Irritation (rabbit) | 00144798<br>97% a.i. | Non-irritating | IV |
| | | 47282501<br>97.1% a.i. | Non-irritating | IV |
| 870.2600 | Dermal Sensitization (guinea pig | 00144800<br>97% a.i. | Negative | N/A |

Toxicological Points of Departure (PODs) Used for Risk Assessment

The toxicological endpoints that were used to complete the occupational and non-occupational exposure assessments are summarized in Tables 3.2 and 3.3. The MCPB risk assessment team recommends that the 10X FQPA SF be reduced to 1X for all exposure scenarios. The toxicology database is complete and exposure analyses are unlikely to underestimate risk of exposure from MCPB. Some of the toxicity data requirements are satisfied for MCPB when supplemented with the MCPA database. MCPA is a structurally similar chlorophenoxy herbicide and differs slightly from MCPB which contains two additional carbon atoms. Metabolic enzymes typically remove carbons two at a time during degradation, in a process called β-oxidation. This results in MCPB being converted to MCPA, which explains the similarities of effects between the two compounds.

The MCPB risk assessments are based on the most sensitive endpoints in the toxicity database for MCPB and MCPA, and the points of departure (PODs) selected for risk assessment are considered protective of any potential adverse effects, including developmental, reproductive, and neurotoxic effects for infants and children.

*Incidental oral exposure (short-term duration):* The two-generation reproduction toxicity study in the rat with MCPA acid was selected to assess the incidental oral route of exposure. The offspring LOAEL of 22.5 mg/kg/day was based on decreased pup weights during lactation (offspring NOAEL = 7.5 mg/kg/day). The LOC is 100 (10X to account for interspecies extrapolation, 10X for intra-species variation, and 1X FPQA SF).

*Dermal exposure (short- and intermediate-term durations):* Although a route-specific study is available, the oral two-generation reproductive toxicity study in the rat was selected due to an increased quantitative postnatal susceptibility (reproductive study) and quantitative susceptibility in the MCPA developmental rat study that is not evaluated in the route specific dermal study. The offspring LOAEL of 22.5 mg/kg/day was based on decreased pup weights during lactation (offspring NOAEL = 7.5 mg/kg/day). The LOC is 100 (10X to account for interspecies extrapolation, 10X for intra-species variation, and 1X FPQA SF).

*Inhalation exposure (short- and intermediate-term durations):* Short- and intermediate-term inhalation endpoints for risk assessment were selected from the route-specific MCPB 28-day inhalation toxicity study in rats with a NOAEC of 0.05 mg/L. At the LOAEC of 0.20 mg/L, squamous metaplasia of the laryngeal respiratory epithelium and hyperplasia and inflammation of the anterior larynx (Level I) and mid larynx (Level II) were noted. HECs/HEDs were calculated. The LOC is 30 [10X to account for interspecies extrapolation, 3X to account for inter-speciation variation (for PD differences)].

MCPB is classified as "not likely to be a human carcinogen" based on the lack of evidence of carcinogenicity in mice and rats following exposure to MCPB, and there is no concern for mutagenicity for both MCPA and MCPB.

**Table 3.2 Toxicological Doses and Endpoints for MCPB for Use in Non-Occupational Human Health Risk Assessments**

| Exposure/ Scenario | Point of Departure | Uncertainty/ FQPA Safety Factors | LOC for Risk Assessment | Study and Toxicological Effects |
|---|---|---|---|---|
| Incidental Oral Short (1-30 days) | Offspring toxicity NOAEL =7.5 mg/kg/day | $UF_A$= 10x<br>$UF_H$= 10x<br>FQPA SF= 1x | Non-Occupational (Spray Drift) LOC = 100 | Two-generation repro rat study – MCPA; MRID 40041701 (1986)<br>Offspring LOAEL =22.5 mg/kg/day based on decreased pup weights during lactation |
| Dermal Short (1-30 days) and Intermediate (1-6 months) Term | Offspring toxicity NOAEL =7.5 mg/kg/day<br><br>DAF = 7.8% | $UF_A$= 10x<br>$UF_H$= 10x<br>FQPA SF= 1x | Non-Occupational (Spray Drift) LOC = 100 | Two-generation repro rat study – MCPA; MRID 40041701 (1986)<br>Offspring LOAEL =22.5 mg/kg/day based on decreased pup weights during lactation |

Point of Departure (POD) = A data point or an estimated point that is derived from observed dose-response data and used to mark the beginning of extrapolation to determine risk associated with lower environmentally relevant human exposures. NOAEL = no observed adverse effect level. LOAEL = lowest observed adverse effect level. UF = uncertainty factor. $UF_A$ = extrapolation from animal to human (interspecies). $UF_H$ = potential variation in sensitivity among members of the human population (intraspecies). FQPA SF= Food Quality Protect Act Safety Factor.

MOE = margin of exposure. LOC = level of concern. DAF = dermal absorption factor [rat in vivo x (human in vitro/rat in vitro) = 50.97 x (11.21/73.3) = 50.97 x (0.153) = 7.8%].

| Table 3.3. Toxicological Doses and Endpoints MCPB for Use in Occupational Human Health Risk Assessments. | | | | |
|---|---|---|---|---|
| Exposure/ Scenario | Point of Departure | Uncertainty Factors | Level of Concern for Risk Assessment | Study and Toxicological Effects |
| Dermal Short- and Intermediate-Term (1-30 days; 1-6 months) | Offspring toxicity NOAEL =7.5 mg/kg/day<br><br>DAF = 7.8% | $UF_A$= 10x<br>$UF_H$= 10x | Occupational LOC = 100 | Two-generation repro rat study – MCPA; MRID 40041701 (1986)<br>Offspring LOAEL =22.5 mg/kg/day based on decreased pup weights during lactation |
| Inhalation Short (1-30 days) and Intermediate (1-6 months) Term | NOAEC = 0.05 mg/L/day<br><br>HEC = 0.009 mg/L/day [A] (occupational handler)<br><br>HED = 0.81 mg/kg/day [B] (occupational handler) | $UF_A$ = 3X<br>$UF_H$ = 10X | Occupational LOC = 30 | 28-day inhalation toxicity in the rat – MCPB acid; MRID 50700001 (2018)<br>LOAEC = 0.20 mg/L/day based on portal-of-entry laryngeal (Level I and II) epithelial squamous metaplasia and hyperplasia and inflammation |
| Cancer (oral, dermal, inhalation) | Classification: "Not likely to be carcinogenic to humans" based on the lack of evidence of carcinogenicity in two adequate rodent carcinogenicity studies. | | | |

Point of Departure (POD) = A data point or an estimated point that is derived from observed dose-response data and used to mark the beginning of extrapolation to determine risk associated with lower environmentally relevant human exposures. NOAEL = no observed adverse effect level. LOAEL = lowest observed adverse effect level. UF = uncertainty factor. $UF_A$ = extrapolation from animal to human (interspecies). $UF_H$ = potential variation in sensitivity among members of the human population (intraspecies). MOE = margin of exposure. LOC = level of concern. DAF = dermal absorption factor [rat in vivo x (human in vitro/rat in vitro) = 50.97 x (11.21/73.3) = 50.97 x (0.153) = 7.8%]

[A] Occupational HEC (portal of entry endpoint) = rat POD * daily duration adjustment * weekly duration adjustment * RDDR = 0.05 mg/L * (6 hrs/8 hrs) * (5 days/5 days) * Extrathoracic RDDR (0.229) = 0.009 mg/L
[B] Occupational handler HED (portal of entry endpoint) = HEC * human specific conversion factor * daily duration * relative activity factor = HEC (0.009 mg/L) * 11.8 L/hr/kg * 8 hrs = 0.81 mg/kg/day

*Absorption*

The previous exposure assessment used a dermal absorption factor (DAF) of 85% and was based on residues detected in urine, feces, cage wash, blood cells, plasma, carcass, and skin (application site) from the *in vivo* dermal penetration study in rats.

The updated DAF used was 7.8% for the exposure assessment and is based on the adjustment of the *in vivo* DAF of 50.97% at the 10-hour post-application of 0.067 mg/cm$^2$ (1/60 aqueous dilution) (MRID 46732601) by consideration of the ratio of the human *in vitro* and rat *in vitro* dermal absorption (MRID 46737501).

*Body Weight*

Since the dermal POD is based on developmental and/or fetal effects, the body weight appropriate for dermal assessments is 69 kg. The body weight used for the inhalation assessment is 80 kg. A body weight of 11 kg was used to assess dermal and incidental oral exposure to children from spray drift.

## 4.0 Use Profile

MCPB is a phenoxy herbicide produced as a sodium salt and an acid and used for pre- and post-emergence selective weed control in pea and mint. The registered products are liquid/SC formulations and the maximum application rate is 1.5 lb ae/acre on peas and 0.5 lb ae/acre on mint. MCPB can be applied as a broadcast application by aerial or by ground equipment. There are no residential uses associated with MCPB.

For occupational use patterns, short- and intermediate-term dermal and inhalation exposures are anticipated for occupational handlers and for post-application workers. Non-occupational exposures from spray drift (dermal and/or incidental oral) are expected to be short-term only.

Registered labels require mixer/loaders, applicators, and other handlers to wear: long sleeved shirt and long pants, shoes and socks, and chemical resistant gloves. Labels include REIs of 12 and 24 hours.

Table 4.1 provides a summary of application rates for the registered use sites. The label information was pulled from the MCPB 019201 PLUS report from the Biological and Economic Analysis Division (BEAD).

**Table 4.1. Summary of Directions for Use of MCPB.**

| Application Timing | Application Equipment | Formulation [EPA Reg. No.] | Applic. Rate (lb ae/A) | Max. No. Applic. per Season | Max. Seasonal Applic. Rate (lb ae/A) | PHI (days) | Use Directions and Limitations |
|---|---|---|---|---|---|---|---|
| **Mint** | | | | | | | |
| Post-emergence | Aerial and Groundboom | Liquid [71368-5] 21.4% acid equivalent | 0.5 | N/S | N/S | 40 | PPE: Long-sleeved shirt, long pants, shoes/socks, protective eyewear, and chemical resistant gloves REI: 24 hours Do not apply this product through any type of irrigation system. |
| **Peas** | | | | | | | |
| Pre-bloom | Aerial and Groundboom | Liquid [15440-38] 21.4% acid equivalent | 1.5 | N/S | N/S | N/S | PPE: Long-sleeved shirt, long pants, shoes/socks, and chemical resistant gloves REI: 12 hours Do not apply this product through any type of irrigation system. |

| Table 4.1. Summary of Directions for Use of MCPB. | | | | | | | |
|---|---|---|---|---|---|---|---|
| **Application Timing** | **Application Equipment** | **Formulation [EPA Reg. No.]** | **Applic. Rate (lb ae/A)** | **Max. No. Applic. per Season** | **Max. Seasonal Applic. Rate (lb ae/A)** | **PHI (days)** | **Use Directions and Limitations** |
| Pre-bloom | | Liquid [71368-5] 21.4% acid equivalent | | N/S | N/S | 40 | PPE: Long-sleeve shirt, long pants, shoes/socks, protective eyewear, and chemical resistant gloves<br>REI: 24 hours<br>Do not apply this product through any type of irrigation system.<br>Do not apply this product later than 3 nodes before pea flower or after pea flower buds appear |

## 5.0 Residential Exposure and Risk Estimates

There are no registered residential uses associated with MCPB; therefore, a quantitative residential assessment was not conducted.

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

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

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

[2] This approach is consistent with the requirements of the EPA's Worker Protection Standard.

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

A screening approach was developed based on the use of the AgDrift model in situations where specific label guidance that defines application parameters is not available.[3] AgDrift is appropriate for use only when applications are made by aircraft, airblast orchard sprayers, and groundboom sprayers. When AgDrift was developed, a series of screening values (i.e., the Tier 1 option) were incorporated into the model and represent each equipment type and use under varied conditions. The screening options specifically recommended in this methodology were selected because they are plausible and represent a reasonable upper bound level of drift for common application methods in agriculture. These screening options are consistent with how spray drift is considered in a number of ecological risk assessments and in the process used to develop drinking water concentrations used for risk assessment. In all cases, each scenario is to be evaluated unless it is not plausible based on the anticipated use pattern (e.g., herbicides are not typically applied to tree canopies) or specific label prohibitions (e.g., aerial applications are not allowed). Section 6.1 provides the screening level drift related risk estimates.
In many cases, risks are of concern when the screening level estimates for spray drift are used as the basis for the analysis. In order to account for this issue and to provide additional risk management options additional spray drift deposition fractions were also considered. These drift estimates represent plausible options for pesticide labels

### 6.1 Combined Risk Estimates from Lawn Deposition Adjacent to Applications

The spray drift risk estimates are based on an estimated deposited residue concentration as a result of the screening level agricultural application scenarios. MCPB is used on mint and peas and can be applied via groundboom and aerial equipment. The recommended drift scenario screening level options are listed below:

- **Groundboom applications** are based on the AgDrift option for high boom height and using very fine to fine spray type using the 90th percentile results.
- **Aerial applications** are based on the use of AgDrift Tier 1 aerial option for a fine to medium spray type and a series of other parameters which will be described in more

[3] https://www.epa.gov/pesticide-science-and-assessing-pesticide-risks/models-pesticide-risk-assessment#AgDrift

detail below (e.g., wind vector assumed to be 10 mph in a downwind direction for entire application/drift event).[4]

A quantitative dermal and incidental oral (for children only) spray drift assessment for adults and children was conducted for MCPB using available MCPA TTR data (MRIDs 44655702 and 45033101). The TTR studies were reviewed and found to be acceptable for risk assessment (Refer to Appendix C for summary). The predicted day 0 residue value of 0.251 ug/cm$^2$ in MRID 44655702 was used to estimate non-occupational spray drift exposure and risk. Adult dermal and children's (1 to <2 years old) combined dermal and incidental oral risk estimates from indirect exposure to MCPB related to spray drift are not of concern (i.e., MOEs ≥ 100) at the field edge for groundboom and aerial applications for mint and peas.

**Table 6.1. Adult Risk Estimates (MOEs) Related to Indirect Exposure to Spray Drift for MCPB for the Dermal Route of Exposure (LOC = 100).**

| Crop/Rate Group | Spray Type/ Nozzle Configuration | Application Rate (lb ae/A) | Estimated TTR (ug/cm$^2$) | MOEs At Field Edge |
|---|---|---|---|---|
| Mint | | | | |
| Aerial | *Fine to Medium* | 0.5 | 0.082 | 1,200 |
| Groundboom | *High Boom Very fine to Fine* | | | 1,600 |
| Peas | | | | |
| Aerial | *Fine to Medium* | 1.5 | 0.244 | 390 |
| Groundboom | *High Boom Very fine to Fine* | | | 540 |

a. Estimated TTR (ug/cm$^2$) = Estimated TTR (ug/cm$^2$) = TTR residue data adjusted for the differences in the study application rate.
b. MOEs at various distances from field edge = Dermal MOES. Dermal POD (7.5 mg/kg/day) ÷ Dose (mg/kg/day), where the dermal dose is calculated using the algorithms provided in the Turf Residential SOPs (http://www.epa.gov/pesticide-science-and-assessing-pesticide-risks/standard-operating-procedures-residential-pesticide), and the TTR used in the calculations is the estimated TTR * drift fraction of spray drift that deposits on lawns at various distances from the field edge (see Appendix B).

**Table 6.2. Children (1 to < 2 years old) Risk Estimates (MOEs) Related to Indirect Exposure to Spray Drift for MCPB for the Combined Dermal and Incidental Oral Routes of Exposure (LOC = 100).**

| Crop/Rate Group | Spray Type/ Nozzle Configuration | Application Rate (lb ae/A) | Estimated TTR (ug/cm$^2$) | MOEs At Field Edge |
|---|---|---|---|---|
| Mint | | | | |
| Aerial | *Fine to Medium* | 0.5 | 0.082 | 540 |
| Groundboom | *High Boom Very fine to Fine* | | | 750 |
| Peas | | | | |
| Aerial | *Fine to Medium* | 1.5 | 0.244 | 180 |
| Groundboom | *High Boom Very fine to Fine* | | | 250 |

a Estimated TTR (ug/cm$^2$) = Estimated TTR (ug/cm$^2$) = TTR residue data adjusted for the differences in the study application rate.

[4] AgDrift allows for consideration of even finer spray patterns characterized as very fine to fine. However, this spray pattern was not selected as the common screening basis since it is used less commonly for most agriculture.

b. MOEs at various distances from field edge = incidental oral and dermal POD (7.5 mg/kg/day) ÷ Combined (dermal + incidental oral) Dose (mg/kg/day), where the incidental oral and dermal dose is calculated using the algorithms provided in the Turf Residential SOPs (http://www.epa.gov/pesticide-science-and-assessing-pesticide-risks/standard-operating-procedures-residential-pesticide), and the TTR used in the calculations is the estimated TTR * drift fraction of spray drift that deposits on lawns at various distances from the field edge (see Appendix B).

## 7.0 Non-Occupational Bystander Post-Application Inhalation Exposure and Risk Estimates

Volatilization of pesticides may be a source of post-application inhalation exposure to individuals nearby pesticide applications. The agency sought expert advice and input on issues related to volatilization of pesticides from its Federal Insecticide, Fungicide, and Rodenticide Act Scientific Advisory Panel (SAP) in December 2009 and received the SAP's final report on March 2, 2010 (http://www.regulations.gov/#!documentDetail;D=EPA-HQ-OPP-2009-0687-0037). The agency has evaluated the SAP report and has developed a Volatilization Screening Tool and a subsequent Volatilization Screening Analysis (http://www.regulations.gov/#!docketDetail;D=EPA-HQ-OPP-2014-0219).
During Registration Review, the agency will utilize this analysis to determine if data (i.e., flux studies, route-specific inhalation toxicological studies) or further analysis is required for MCPB.

## 8.0 Occupational Exposure and Risk Estimates

### 8.1 Occupational Handler Exposure/Risk Estimates

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

Based on the anticipated use patterns and current labeling, types of equipment and techniques that can potentially be used, occupational handler exposure is expected from the proposed uses. The quantitative exposure/risk assessment developed for occupational handlers is based on the scenarios listed in Table 8.1.1.

<u>Occupational Handler Exposure Data and Assumptions</u>
A series of assumptions and exposure factors served as the basis for completing the occupational handler risk assessments. Each assumption and factor is detailed below on an individual basis.

*Application Rate*:
Table 4.1 provides a summary of application rates for the registered use sites. The label information was pulled from the MCPB 019201 PLUS report from BEAD.

*Unit Exposures:* It is the policy of HED to use the best available data to assess handler exposure. Sources of generic handler data, used as surrogate data in the absence of chemical-specific data, include PHED 1.1, the AHETF database, or other registrant-submitted occupational exposure studies. Some of these data are proprietary (e.g., AHETF data), and subject to the data protection provisions of FIFRA. The standard values recommended for use in predicting handler exposure that are used in this assessment, known as "unit exposures", are outlined in the "Occupational Pesticide Handler Unit Exposure Surrogate Reference Table[5].", which, along with additional information on HED policy on use of surrogate data, including descriptions of the various sources, can be found at the Agency website[5].

*Area Treated or Amount Handled:*
The area treated/amount handled are based on ExpoSAC Policy 9.1.

*Exposure Duration:*
HED classifies exposures from 1 to 30 days as short-term and exposures 30 days to six months as intermediate-term. Exposure duration is determined by many things, including the exposed population, the use site, the pest pressure triggering the use of the pesticide, and the cultural practices surrounding that use site. For most agricultural uses, it is reasonable to believe that occupational handlers will not apply the same chemical every day for more than a one-month time frame; however, there may be a large agribusiness and/or commercial applicators who may apply a product over a period of weeks (e.g., completing multiple applications for multiple clients within a region).

For MCPB, based on the registered uses, short- and intermediate-term exposure(s) are expected. Since the same endpoint and POD was selected for short- and intermediate-term durations, short-term exposure and risk estimates are considered to be protective of potential intermediate-term exposure and risk.

*Mitigation/Personal Protective Equipment:* Estimates of dermal and inhalation exposure were calculated for various levels of PPE. Results are presented for label specified PPE, defined as a single layer of clothing consisting of a long-sleeved shirt, long pants, shoes plus socks, gloves, and no respirator, as well as with various levels of PPE as necessary (e.g., double layer, etc).

Occupational Handler Non-Cancer Exposure and Risk Estimate Equations
The algorithms used to estimate non-cancer exposure and dose for occupational handlers can be found in Appendix A.

Combining Exposures/Risk Estimates:
Dermal and inhalation risk estimates were not combined in this assessment, since the toxicological effects for these exposure routes were not similar.

Summary of Occupational Handler Non-Cancer Exposure and Risk Estimates
All dermal scenarios resulted in no risk estimates of concern for MCPB at baseline PPE (i.e., single layer with gloves); all MOEs were ≥ the LOC of 100.

There were no inhalation risk estimates of concern for MCPB at baseline (i.e., no respirator); all MOEs were ≥ the LOC of 30.

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[5] https://www.epa.gov/sites/production/files/2018-06/documents/opp-hed-pesticide-handler-surrogate-unit-exposure-table-june-2018.pdf

The Agency matches quantitative occupational exposure assessment with appropriate characterization of exposure potential. While HED presents quantitative risk estimates for human flaggers where appropriate, agricultural aviation has changed dramatically over the past two decades. According the 2012 National Agricultural Aviation Association (NAAA) survey of their membership, the use of GPS for swath guidance in agricultural aviation has grown steadily from the mid 1990's. Over the same time period, the use of human flaggers for aerial pesticide applications has decreased steadily from ~15% in the late 1990's to only 1% in the most recent (2012) NAAA survey. The Agency will continue to monitor all available information sources to best assess and characterize the exposure potential for human flaggers in agricultural aerial applications.

HED has no data to assess exposures to pilots using open cockpits. The only data available is for exposure to pilots in enclosed cockpits. Therefore, risks to pilots are assessed using the engineering control (enclosed cockpits) and baseline attire (long-sleeve shirt, long pants, shoes, and socks); per the Agency's Worker Protection Standard stipulations for engineering controls, pilots are not required to wear protective gloves for the duration of the application. With this level of protection, there are no risk estimates of concern for applicators.

| Table 8.1.1. Occupational Handler Non-Cancer Exposure and Risk Estimates for MCPB. | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Exposure Scenario | Crop or Target | Dermal Level of Concern (LOC) | Inhalation Level of Concern (LOC) | Dermal Unit Exposure (µg/lb ai)[1] Level of PPE or Engineering control | Inhalation Unit Exposure (µg/lb ai)[1] Level of PPE or Engineering control | Maximum Application Rate[2] | Area Treated or Amount Handled Daily[3] | Dermal | | Inhalation | |
| | | | | | | | | Dose (mg/kg/day)[4] | MOE[5] | Dose (mg/kg/day)[6] | MOE[7] |
| Mixer/Loader | | | | | | | | | | | |
| Liquid, Aerial, Broadcast | Field crop, typical | 100 | 30 | 37.6 SL/G | 0.219 No-R | 1.5 lb ae/A | 350 A | 0.0223 | 340 | 0.00144 | 560 |
| Liquid, Aerial, Broadcast | Field crop, high-acreage | | | 37.6 SL/G | 0.219 No-R | 0.5 lb ae/A | 1200 A | 0.0255 | 290 | 0.00164 | 490 |
| Liquid, Groundboom, Broadcast | Field crop, typical | | | 37.6 SL/G | 0.219 No-R | 1.5 lb ae/A | 80 A | 0.0051 | 1500 | 0.000329 | 2,500 |
| Liquid, Groundboom, Broadcast | Field crop, high-acreage | | | 37.6 SL/G | 0.219 No-R | 0.5 lb ae/A | 200 A | 0.00425 | 1800 | 0.000274 | 3,000 |
| Applicator | | | | | | | | | | | |
| Spray (all starting formulations), Aerial, Broadcast | Field crop, typical | 100 | 30 | 2.08 EC | 0.0049 EC | 1.5 lb ae/A | 350 A | 0.00123 | 6100 | 0.0000321 | 25,000 |
| Spray (all starting formulations), Aerial, Broadcast | Field crop, high-acreage | | | 2.08 EC | 0.0049 EC | 0.5 lb ae/A | 1200 A | 0.00141 | 5300 | 0.0000368 | 22,000 |
| Spray (all starting formulations), Groundboom, Broadcast | Field crop, typical | | | 16.1 SL/G | 0.34 No-R | 1.5 lb ae/A | 80 A | 0.00218 | 3400 | 0.00051 | 1,600 |
| Spray (all starting formulations), Groundboom, Broadcast | Field crop, high-acreage | | | 16.1 SL/G | 0.34 No-R | 0.5 lb ae/A | 200 A | 0.00182 | 4100 | 0.000425 | 1,900 |
| Flagger | | | | | | | | | | | |
| Spray (all starting formulations), Aerial, Broadcast | Field crop, typical | 100 | 30 | 12 SL/G | 0.35 No-R | 1.5 lb ae/A | 350 A | 0.00712 | 1100 | 0.0023 | 350 |
| Spray (all starting formulations), Aerial, Broadcast | Field crop, high-acreage | | | 12 SL/G | 0.35 No-R | 0.5 lb ae/A | 350 A | 0.00237 | 3200 | 0.000766 | 1,100 |

1 Based on the "Occupational Pesticide Handler Unit Exposure Surrogate Reference Table" (https://www.epa.gov/pesticide-science-and-assessing-pesticide-risks/occupational-pesticide-handler-exposure-data); Level of mitigation: Baseline, PPE, Eng. Controls.
2 Based on registered labels (Reg. No. 7138-5; 15440-38).
3 Exposure Science Advisory Council Policy #9.1.
4 Dermal Dose = Dermal Unit Exposure (µg/lb ai) × Conversion Factor (0.001 mg/µg) × Application Rate (lb ae/acre) × Area Treated or Amount Handled Daily (A) × DAF (7.8 %) ÷ BW (69 kg).
5 Dermal MOE = Dermal NOAEL (7.5 mg/kg/day) ÷ Dermal Dose (mg/kg/day).
6 Inhalation Dose = Inhalation Unit Exposure (µg/lb ai) × Conversion Factor (0.001 mg/µg) × Application Rate (lb ae/acre) × Area Treated or Amount Handled Daily (A ) ÷ BW (80 kg).
7 Inhalation MOE = Inhalation HED (0.81 mg/kg/day) ÷ Inhalation Dose (mg/kg/day).
Typical acreage = peas; high acreage = mint

## 8.2 Occupational Post-application Exposure/Risk Estimates

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

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

There are multiple potential sources of post-application inhalation exposure to individuals performing post-application activities in previously treated fields. These potential sources include volatilization of pesticides and resuspension of dusts and/or particulates that contain pesticides. The Agency sought expert advice and input on issues related to volatilization of pesticides from its Federal Insecticide, Fungicide, and Rodenticide Act Scientific Advisory Panel (SAP) in December 2009 and received the SAP's final report on March 2, 2010 (http://www.regulations.gov/#!documentDetail;D=EPA-HQ-OPP-2009-0687-0037). The Agency has evaluated the SAP report and has developed a Volatilization Screening Tool and a subsequent Volatilization Screening Analysis (https://www.regulations.gov/#!docketDetail;D=EPA-HQ-OPP-2014-0219). During Registration Review, the Agency will utilize this analysis to determine if data (i.e., flux studies, route-specific inhalation toxicological studies) or further analysis is required for MCPB.

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

Although a quantitative occupational post-application inhalation exposure assessment was not performed, an inhalation exposure assessment was performed for occupational/commercial handlers. Handler exposure resulting from application of pesticides outdoors is likely to result in higher exposure than post-application exposure. Therefore, it is expected that these handler inhalation exposure estimates would be protective of most occupational post-application inhalation exposure scenarios.

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

<u>Occupational Post-application Dermal Exposure Data and Assumptions</u>
A series of assumptions and exposure factors served as the basis for completing the occupational post-application risk assessments. Each assumption and factor is detailed below on an individual basis.

*Exposure Duration:* HED classifies exposures from 1 to 30 days as short-term and exposures 30 days to six months as intermediate-term. For MCPB, based on the registered uses, short- and intermediate-term exposures are expected.

*Transfer Coefficients:* It is the policy of HED to use the best available data to assess post-application exposure. Sources of generic post-application data, used as surrogate data in the absence of chemical-specific data, are derived from ARTF exposure monitoring studies, and, as proprietary data, are subject to the data protection provisions of FIFRA. The standard values recommended for use in predicting post-application exposure that are used in this assessment, known as "transfer coefficients", are presented in the ExpoSAC Policy 3[6]" which, along with additional information about the ARTF data, can be found at the Agency website[7]. Table 8.2.2.1 provides a summary of the anticipated post-application activities and associated transfer coefficients for the proposed crops/use sites.

**Table 8.2.2.1. Anticipated Post-Application Activities and Dermal Transfer Coefficients.**

| Proposed Crops | Policy Crop Group Category | Crop Height | Foliage Density | Transfer Coefficients ($cm^2/hr$) | Activities |
|---|---|---|---|---|---|
| Mint | Herbs and spices | Low | Min/Full | 1900 | Irrigation (handset) |
| | | Low | Min/Full | 1100 | Scouting |
| | | Low | Min/Full | 70 | Weeding, hand |
| Peas | Vegetable, legume, edible, podded | Low | Min/Full | 1900 | Irrigation (handset) |
| | | Low | Min/Full | 210 | Scouting |
| | | Low | Min/Full | 70 | Weeding, hand |
| | | Low | Full | 1100 | Harvesting, hand |

*Application Rate:* See Table 4.1 for application rates.

*Exposure Time:* The average occupational workday is assumed to be 8 hours.

*Dislodgeable Foliar Residues:* Chemical-specific dislodgeable foliar residue (DFR) data are available for MCPB and were used in the assessment for both mint and pea. A summary is provided below.

MRID 50515601: Determination of Dislodgeable Foliar Residues on Pea Foliage Treated with MCPB (U. Hassan, D445914, 06/10/2019).

[6] Available: https://www.epa.gov/pesticide-science-and-assessing-pesticide-risks/occupational-pesticide-handler-exposure-data
[7] Available: https://www.epa.gov/pesticide-science-and-assessing-pesticide-risks/occupational-pesticide-handler-exposure-data

Study Summary: The trial was conducted in two test sites during the 2017 growing season: North Dakota and Washington. One application was made to pea foliage at a target application rate of 1.5 lb ae/A. Actual application rates were 1.49-1.50 lb ae/A MCPB (99.5-100% of target). Leaf samples were collected prior to and immediately after the application (when spray on the crop leaves had dried), 4, 8 hours after the application, and at 1, 2, 3, 5, 7, 9/10, 14, 21, 28, and 35 days after treatment (DAT). At each sampling interval, three replicate DFR samples were collected from the treated plot. One control sample was collected from the control plot at each sampling interval. At the North Dakota (ND) site, average residues of MCPB (and percent of application rate) were highest immediately after the application (0DAT) at 1,937 ng/cm$^2$ (11.6%) and declined rapidly to below LOQ at 3DAT, except for one slight increase at 1,709 ng/cm$^2$ (10.2%) at 0.33DAT. Dissipation of residues was possibly affected by rainfall. The Study Report reported 0.11 inches of rain at 1DAT. A total of 2.33 inches of rain fell during the trial period. At the Washington (WA) site, average residues of MCPB (and percent of application rate) were highest immediately after the application (0DAT) at 1,431 ng/cm$^2$ (8.5%) and declined steadily to below LOQ at 14DAT. There was no rain during the trial period which may account for the slower dissipation of residues. HED assumed first-order dissipation kinetics to generate dissipation curves for MCPB using average corrected DFR values collected after the application through the first interval where all individual values were <LOQ. For the ND site, dissipation curves were prepared using average corrected DFR values through 3DAT. For the WA site, dissipation curves were prepared using average corrected DFR values through 14DAT. HED calculated half-lives on pea leaves are 0.4 days ($R^2$ = 0.9173) at the North Dakota site and 1.7 days ($R^2$ = 0.9173) at the Washington site. The predicted day 0 value of 714.9 ng/cm$^2$ (0.715 mg/cm$^2$) from the Washington test site was used to estimate occupational post-application exposure and risk; it would be considered protective of the North Dakota test site. No adjustment was necessary for the application rate for pea since the study application rate and the registered label rates are the same.

The DFR estimates for mint were adjusted from the pea DFR Study. The label rate (0.5 lb ai/A) for mint was less than that used in the study (1.5 lb ai/A). The DFR estimate was adjusted by the ratio of the label application rate to the study application rate. This factor was applied to the pea DFR study data (0.715 mg/cm$^2$ x (0.5 lb ai/A ÷1.5 lb ai/A) = 0.238 mg/cm$^2$)

Occupational Post-application Non-Cancer Dermal Exposure and Risk Estimate Equations
The algorithms used to estimate non-cancer exposure and dose for occupational post-application workers can be found in Appendix A.

Occupational Post-application Non-Cancer Dermal Risk Estimates
All occupational post-application dermal risk estimates are not of concern (MOE ≥ 100, LOC = 100).

| Table 8.2.2.2. Occupational Post-application Non-Cancer Exposure and Risk Estimates for MCPB. | | | | | |
|---|---|---|---|---|---|
| **Crop/Site** | **Activities** | **Transfer Coefficient ($cm^2$/hr)** | **DFR[1]** | **Dermal Dose (mg/kg/day)[2]** | **MOE[3]** |
| Short- and Intermediate-term | | | | | |
| Mint | Irrigation (handset) | 1900 | 0.238 | 0.004 | 1,800 |
| | Scouting | 1100 | 0.238 | 0.002 | 3,200 |
| | Weeding, hand | 70 | 0.238 | 0.0002 | 50,000 |
| Peas | Irrigation (handset) | 1900 | 0.715 | 0.012 | 610 |
| | Harvesting, hand | 1100 | 0.715 | 0.007 | 1,100 |
| | Scouting | 210 | 0.715 | 0.001 | 5,500 |
| | Weeding, hand | 70 | 0.715 | 0.0005 | 17,000 |

1 DFR = MRID 50515601 for pea, 0.715 mg/$cm^2$ x (0.5 lb ai/A ÷1.5 lb ai/A) = 0.238 mg/$cm^2$ for mint
2 Daily Dermal Dose = [DFR (ng/$cm^2$) × Transfer Coefficient × 0.001 mg/µg × 8 hrs/day × dermal absorption (7.8%)] ÷ BW (69 kg).
3 MOE = POD (7.5 mg/kg/day) / Daily Dermal Dose.

<u>Restricted Entry Interval</u>

MCPB is classified as Toxicity Category III via the dermal route and Toxicity Category IV for skin irritation potential. It is not a skin sensitizer. Short- and intermediate-term post-application risk estimates were not a concern on day 0 (12 hours following application) for all post-application activities. Under 40 CFR 156.208 (c) (2), ai's classified as Acute III or IV for acute dermal, eye irritation and primary skin irritation are assigned a 12-hour REI. Therefore, the [156 subpart K] Worker Protection Statement interim REI of 12 hours is adequate to protect agricultural workers from post-application exposures to MCPB. HED would recommend a REI of 12 hours.

**Appendix A. Summary of Occupational and Residential Non-cancer Algorithms**

Occupational Non-cancer Handler Algorithms

Potential daily exposures for occupational handlers are calculated using the following formulas:

$$E = UE * AR * A * 0.001\ mg/ug$$

where:

| | | |
|---|---|---|
| E | = | exposure (mg ai/day), |
| UE | = | unit exposure (µg ai/lb ai), |
| AR | = | maximum application rate according to proposed label (lb ai A or lb ai/gal), and |
| A | = | area treated or amount handled (e.g., A/day, gal/day). |

The daily doses are calculated using the following formula:

$$ADD = \frac{E * AF}{BW}$$

where:

| | | |
|---|---|---|
| ADD | = | average daily dose absorbed in a given scenario (mg ai/kg/day), |
| E | = | exposure (mg ai/day), |
| AF | = | absorption factor (dermal and/or inhalation), and |
| BW | = | body weight (kg). |

*Margin of Exposure:* Non-cancer risk estimates for each application handler scenario are calculated using a Margin of Exposure (MOE), which is a ratio of the toxicological endpoint to the daily dose of concern. The daily dermal and inhalation dose received by occupational handlers are compared to the appropriate POD (i.e., NOAEL) to assess the risk to occupational handlers for each exposure route. All MOE values are calculated using the following formula:

$$MOE = \frac{POD}{ADD}$$

where:

| | | |
|---|---|---|
| MOE | = | margin of exposure: value used by HED to represent risk estimates (unitless), |
| POD | = | point of departure (mg/kg/day), and |
| ADD | = | average daily dose absorbed in a given scenario (mg ai/kg/day). |

Occupational Non-cancer Post-application Algorithms

Potential daily exposures for occupational post-application workers are calculated using the following formulas:

$$DFR_t = AR * F * (1\text{-}D)^t * \left(4.54E8 \frac{ug}{lb}\right) * \left(2.47E\text{-}8 \frac{A}{cm^2}\right)$$

where:

| | | |
|---|---|---|
| $DFR_t$ | = | dislodgeable foliage residue on day "t" ($\mu g/cm^2$), |
| AR | = | application rate (lb ai/acre), |
| F | = | fraction of ai retained on foliage or 25% (unitless), |
| D | = | fraction of residue that dissipates daily or 10% (unitless), and |
| t | = | number of days after application day (days). |

$$E = TC * DFR_t * ET * 0.001 \frac{mg}{ug}$$

where:

| | | |
|---|---|---|
| E | = | exposure (mg ai/day), |
| TC | = | transfer coefficient ($cm^2/hr$), |
| $DFR_t$ | = | dislodgeable foliar residue on day "t" ($\mu g/cm^2$), and |
| ET | = | exposure time (hours/day). |

The daily doses are calculated using the following formula:

$$ADD = \frac{E * AF}{BW}$$

where:

| | | |
|---|---|---|
| ADD | = | average daily dose absorbed in a given scenario (mg ai/kg/day), |
| E | = | exposure (mg ai/day), |
| AF | = | absorption factor (dermal and/or inhalation), and |
| BW | = | body weight (kg). |

*Margin of Exposure:* Non-cancer risk estimates for each scenario are calculated using a Margin of Exposure (MOE), which is a ratio of the toxicological endpoint to the daily dose of concern. The daily dermal dose received by occupational post-application workers is compared to the appropriate POD (i.e., NOAEL) to assess the risk to occupational post-application workers. All MOE values are calculated using the following formula:

$$MOE = \frac{POD}{ADD}$$

where:

| | | |
|---|---|---|
| MOE | = | margin of exposure: value used by HED to represent risk estimates (unitless), |
| POD | = | point of departure (mg/kg/day), and |
| ADD | = | average daily dose absorbed in a given scenario (mg ai/kg/day). |

## Appendix B. Summary of Spray Drift Algorithms

Modified TTR Equation to Account for Spray Drift

The equation presented below, should be used to evaluate potential risks from spray drift. This equation is similar to the standard TTR equation, except that an additional term has been included (DF or Drift Fraction) that provides an adjustment for the amount of drift that moves into and deposits in a non-target area, such as a lawn. This equation applies to situations where TTR data are not available.

$$TTR = AR * DF * F * (1\text{-}D)^t * CF2 * CF3$$

where:

| | | |
|---|---|---|
| TTR | = | turf transferable residue ($\mu g/cm^2$) |
| DF | = | drift fraction of spray drift that deposits on lawns (unitless) |
| AR | = | application rate (lbs ai/$ft^2$ or lb ai/acre) |
| F | = | fraction of ai as transferable residue following application (unitless) |
| D | = | fraction of residue that dissipates daily (unitless) |
| T | = | post-application day on which exposure is being assessed (Day 0 in this SOP) |
| CF2 | = | weight unit conversion factor ($4.54 \times 10^8$ µg/lb) |
| CF3 | = | area unit conversion factor ($1.08 \times 10^{-3}$ $ft^2$/ $cm^2$ or $2.47 \times 10^{-8}$ acre/$cm^2$) |

If chemical specific TTR data are available, the residue on Day 0 is used after it is adjusted based on the ratio of the applicable application rate for risk assessment (i.e., based on the crop of concern) and the application rate for the TTR study followed by an additional adjustment for the drift fraction factor as illustrated above.

Drift Fraction Values

The spray drift fraction (DF) values for selected aerial and groundboom application scenarios, based on average deposition values at each distance of interest, are shown in the tables below (Tables B-1, -2).

**Table B-1. Average Drift Fractions for a 50' Wide Lawn Starting at Various Distances Downwind From a Field Treated Using Aerial Equipment.**

| Droplet Size+ | Distance Downwind From Treated Field (feet) | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | 0 | 10 | 25 | 50 | 75 | 100 | 125 | 150 | 200 | 250 | 300 |
| ***Fine to Medium**** | ***0.257*** | ***0.209*** | ***0.169*** | ***0.129*** | ***0.098*** | ***0.076*** | ***0.063*** | ***0.054*** | ***0.041*** | ***0.034*** | ***0.028*** |
| **Medium to Coarse*** | **0.211** | **0.156** | **0.115** | **0.082** | **0.058** | **0.044** | **0.035** | **0.029** | **0.021** | **0.016** | **0.013** |
| Coarse to Very Coarse* | 0.183 | 0.124 | 0.082 | 0.053 | 0.037 | 0.028 | 0.022 | 0.018 | 0.013 | 0.010 | 0.008 |
| Very Fine to Fine* | 0.373 | 0.340 | 0.305 | 0.262 | 0.226 | 0.197 | 0.175 | 0.155 | 0.127 | 0.108 | 0.095 |
| AT401, M, 10 mph, 34% SD | 0.234 | 0.183 | 0.142 | 0.105 | 0.078 | 0.060 | 0.049 | 0.042 | 0.032 | 0.026 | 0.021 |
| WASP, M, 10 mph, 34% SD | 0.218 | 0.171 | 0.129 | 0.086 | 0.063 | 0.049 | 0.040 | 0.034 | 0.026 | 0.021 | 0.018 |
| AT401, C, 10 mph, 25% SD | 0.198 | 0.141 | 0.099 | 0.067 | 0.047 | 0.036 | 0.029 | 0.024 | 0.017 | 0.013 | 0.011 |
| WASP, C, 10 mph, 25% SD | 0.171 | 0.121 | 0.084 | 0.053 | 0.038 | 0.028 | 0.023 | 0.018 | 0.013 | 0.010 | 0.009 |

| Table B-1. Average Drift Fractions for a 50' Wide Lawn Starting at Various Distances Downwind From a Field Treated Using Aerial Equipment. | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| **Droplet Size+** | **Distance Downwind From Treated Field (feet)** | | | | | | | | | | |
| | 0 | 10 | 25 | 50 | 75 | 100 | 125 | 150 | 200 | 250 | 300 |
| AT401, VC, 10 mph, 20% SD | 0.175 | 0.115 | 0.072 | 0.044 | 0.031 | 0.023 | 0.018 | 0.014 | 0.010 | 0.008 | 0.006 |
| WASP, VC, 10 mph, 20% SD | 0.138 | 0.088 | 0.057 | 0.036 | 0.025 | 0.019 | 0.014 | 0.012 | 0.008 | 0.007 | 0.006 |

*Information is based on the Tier 1 option in the AgDrift model. The fine to medium spray quality is used in this SOP as the basis for the screening level assessment. These are all based on fixed wing aircraft.
+For further options the AT401 is the representative fixed wing aircraft and the Wasp is the representative helicopter. SD = swath displacement. SD values for non-Tier I options computed using AgDrift automated adjustment option.

**Spray Quality Summaries:** Fine to Medium (F2M): $D_{v0.5}$ = 255 µM; Medium (M): $D_{v0.5}$ = 294 µM; Medium to Coarse (M2C): $D_{v0.5}$ = 341 µM; Coarse (C) $D_{v0.5}$ = 385 µM; Coarse to Very Coarse (C2VC): $D_{v0.5}$ = 439 µM;Very

| Table B-2. Average Drift Fractions for a 50' Wide Lawn Starting at Various Distances Downwind From a Field Treated Using Ground Equipment. | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Boom Height** | **Droplet Size** | **Distance Downwind From Treated Field (feet)** | | | | | | | | | | |
| | | 0 | 10 | 25 | 50 | 75 | 100 | 125 | 150 | 200 | 250 | 300 |
| ***High*** | ***Very Fine to Fine*** | ***0.187*** | ***0.093*** | ***0.056*** | ***0.035*** | ***0.025*** | ***0.020*** | ***0.017*** | ***0.014*** | ***0.011*** | ***0.008*** | ***0.007*** |
| Low | Very Fine to Fine | 0.085 | 0.032 | 0.020 | 0.013 | 0.010 | 0.008 | 0.007 | 0.006 | 0.005 | 0.004 | 0.003 |
| **High** | **Fine to Medium/Coars** | **0.049** | **0.019** | **0.013** | **0.009** | **0.007** | **0.006** | **0.005** | **0.005** | **0.004** | **0.003** | **0.003** |
| Low | Fine to Medium/Coarse | 0.033 | 0.012 | 0.008 | 0.006 | 0.005 | 0.004 | 0.003 | 0.003 | 0.002 | 0.002 | 0.002 |

Low Boom 0.508 m (20 in), High Boom 1.27 m (50 in)
Fine to Medium/Coarse (F2M/C): Avg. Droplet size ($D_{v0.5}$) = 341 µM

## Post-application Dermal Exposure Algorithm—Physical Activities on Turf

Exposure resulting from contacting previously treated turf while performing physical activities is calculated as shown below:

$$E = TTR_t \times CF1 \times TC \times ET$$

where:

| | | |
|---|---|---|
| E | = | exposure (mg/day); |
| $TTR_t$ | = | turf transferable residue on day t (µg/cm$^2$); |
| CF1 | = | weight unit conversion factor (0.001 mg/µg); |
| TC | = | transfer coefficient (cm$^2$/hr); and |
| ET | = | exposure time (hr/day). |

Dermal absorbed doses are calculated as:

$$D = \frac{E \times AF}{BW}$$

where:

| | | |
|---|---|---|
| D | = | dose (mg/kg-day); |

| | | |
|---|---|---|
| E | = | exposure (mg/day); |
| AF | = | absorption factor (dermal); and |
| BW | = | body weight (kg). |

**Table B-4. Turf (Physical Activities) – Recommended Point Estimates for Post-Application Dermal Exposure Factors**

| Algorithm Notation | Exposure Factor (units) | | | Point Estimate(s) |
|---|---|---|---|---|
| AR | Application rate (mass active ingredient per unit area) | | | See Table 4.1. |
| F | Fraction of AR as TTR following application (if chemical-specific data are unavailable) | | L/WP/WDG | 0.01 |
| | | | Granules | 0.002 |
| $F_D$ | Daily residue dissipation (if chemical-specific data are unavailable) (fraction) | | L/WP/WDG | 0.1 |
| | | | Granules | 0.1 |
| TC | Transfer Coefficient ($cm^2$/hr) | L/WP/WDG | Adults | 180,000 |
| | | | Children 1 < 2 years old | 49,000 |
| | | Granules | Adults | 200,000 |
| | | | Children 1 < 2 years old | 54,000 |
| ET | Exposure Time (hours per day) | | Adults | 1.5 |
| | | | Children 1 < 2 years old | 1.5 |
| BW | Body Weight (kg) | | Adults | 69 |
| | | | Children 1 < 2 years old | 11 |

<u>Post-application Hand-to-Mouth Exposure Algorithm—Physical Activities on Turf</u>

Exposure from hand-to-mouth activity is calculated as follows (based on the algorithm utilized in the SHEDS-Multimedia model):

$$E = [HR * (F_M * SA_H) * (ET * N\_Replen) * (1- (1- SE)^{(Freq\_HtM/N\text{-}Replen)})]$$

where:

| | | |
|---|---|---|
| E | = | exposure (mg/day); |
| HR | = | hand residue loading (mg/$cm^2$); |
| FM | = | fraction hand surface area mouthed / event (fraction/event); |
| SAH | = | typical surface area of one hand ($cm^2$); |
| ET | = | exposure time (hr/day); |
| N_Replen | = | number of replenishment intervals per hour (intervals/hour); |
| SE | = | saliva extraction factor (i.e., mouthing removal efficiency); and |
| Freq_HtM | = | number of hand-to-mouth contact events per hour (events/hour). |

and

$$HR = \frac{Fai_{hands} * DE}{SA_H * 2}$$

where:

| | | |
|---|---|---|
| HR | = | hand residue loading (mg/$cm^2$); |
| $Fai_{hands}$ | = | fraction ai on hands compared to total surface residue from dermal |

| | | |
|---|---|---|
| | | transfer coefficient study (unitless); |
| DE | = | dermal exposure (mg); and |
| $SA_H$ | = | typical surface area of one hand ($cm^2$). |

Dose, normalized to body weight, is calculated as:

$$D = \frac{E}{BW}$$

where:

| | |
|---|---|
| D | = dose (mg/kg-day); |
| E | = exposure (mg/day); and |
| BW | = body weight (kg). |

| Table B-5. Turf (Physical Activities) – Inputs for Residential Post-application Hand-to-Mouth Exposure | | | |
|---|---|---|---|
| **Algorithm Notation** | **Exposure Factor (units)** | | **Point Estimate(s)** |
| $Fai_{hands}$ | Fraction of ai on hands from dermal transfer coefficient study (unitless) | Liquid formulations | 0.06 |
| | | Granular formulations | 0.027 |
| DE | Dermal exposure (mg) | | Calculated |
| $SA_H$ | Typical surface area of one hand ($cm^2$), children 1 < 2 years old | | 150 |
| AR | Application rate (mass active ingredient per unit area) | | 0.5 |
| HR | Residue available on the hands ($mg/cm^2$) | | Calculated via (DE * $Fai_{hands}$)/$SA_H$ |
| $F_M$ | Fraction hand surface area mouthed (fraction/event) | | 0.127 |
| N_Replen | Replenishment intervals per hour (intervals/hr) | | 4 |
| ET | Exposure time (hrs/day) | | 1.5 |
| SE | Saliva extraction factor (unitless) | | 0.48 |
| Freq_HtM | Hand-to-mouth events per hour (events/hr) | | 13.9 |
| BW | Body Weight (kg) | Children 1 < 2 years old | 11 |

## Appendix C. Summaries of Available TTR Data

*MRID 44655702: Determination of Transferable Residues on Turf Treated with 2,4-D, 2,4-DP-p, MCPA, MCPP-p, and Dicamba. A. LaMay, D410014, 03/14/2014.*

The trial was conducted at one commercial turf farm in the United States (Franklin County, North Carolina), consisting of 10 established turf plots, including one control plot (TRT1) and one plot for each of the test substances (TRT2 – TRT9). Residues were sampled using the modified California cloth roller technique. Triplicate TTR samples were collected from the treated plots before the application, at 3 and 8-12 hrs after the application, and then at 1, 2, 3, 4, 5, 6, 7, 10, and 14 days after the application. TTRs were corrected using the analyte specific average field fortification recoveries. First-order dissipation kinetics were assumed to generate dissipation curves for 2,4-D 2-EHE, 2,4-D, MCPA 2-EHE, MCPA, 2,4-DP 2-EHE, 2,4-DP, MCPP, and dicamba. The linear regression analysis was conducted using the natural logarithm of the individual foliar residue values collected immediately after the application through the first sampling interval where all replicates demonstrated TTRs less than the limit of quantitation (<LOQ). The data are summarized below in Table 5.2.1.

**Table 5.2.1. Summary of TTR Values and Linear Regression Analysis Results for Treated Turf with MCPA (MRID 44655702).**

| Parameter | Clean Crop MCP4 Ester Herbicide | Clean Crop MCP Amine 4 |
|---|---|---|
| | North Carolina | North Carolina |
| Application Rate (lb ae/A)<br>Target Appl. Rate = 1.5 lb ae/A | 1.54 | 1.55 |
| Measured Actual Average Day 0 (8-12 hour) Residue (µg/cm$^2$) | 0.1908 | 0.2535 |
| Predicted Day 0 Residue (µg/cm$^2$) | **0.251** | 0.091 |
| Slope | -0.741 | -0.494 |
| Half-life (days) | 0.9 | 1.4 |
| $R^2$ | 0.9387 | 0.7269 |

Note: Linear regression analysis based on DFRs collected after the third application.

*MRID 45033101: Determination of Transferable Residues on Turf Treated with 2,4-D DMA, MCPA DMA, 2,4-D DMA + MCPP-p DMA + Dicamba DMA and MCPA DMA + MCPP-p DMA + 2,4-DP-p DMA. A. LaMay, D410012, 03/14/2013.*

Trials were conducted at two locations in the United States (Tulare County, California and Dane County, Wisconsin). Residues were sampled using the modified California cloth roller technique. Triplicate TTR samples were collected from the treated plots before the application, at 1, 4, 8, and 12 hrs after the application, and then at 1, 2, 3, 4, and 7 days after the application. TTRs were corrected using the average concurrent recovery for 2,4-D, MCPA, MCPP, dicamba, or 2,4-DP from each site. A linear regression analysis was not performed due to the nature of the dissipation pattern (i.e. peak residues generally observed at the 8- or 12-hr sampling interval).

At the CA site, the highest average TTR values occurred 12 hrs after the application and residues were still above the LOQ at the last sampling interval (7 days after treatment; DAT) for all analytes and all treatments. At the WI site, the highest average TTR values occurred 1 hr after application for TRT 2 and TRT 3, and 8 hrs after application for TRT 4 and TRT 5 (except for MCPP in TRT 4, in which the highest average residue occurred 1 hr after application). Residues dropped to below the LOQ by 1DAT for all analytes and all treatments at the WI site. The lower residues and earlier maximum TTR values at the WI site are likely due to rainfall during sampling. Rain began to fall lightly during the 8-hr sampling interval, after samples for treatments 1 and 2 had been collected. TTR cloths collected in treatments 3-5 were damp from the falling rain during sampling. A total of 0.025 inch fell by the end of the 8-hr sampling interval. An additional 0.145 inches fell between the 8- and 12-hr sampling (0.17 inch total for the day). All subsequent TFR samples were damp resulting from humid conditions (dew or overnight rainfall). A summary of the highest average TTR values for each treatment type is provided below.

- **TRT 3 (Clean Crop MCP Amine 4):** The highest average TTR values (and percent of application rate) for MCPA were 1.04 $\mu g/cm^2$ (6.28%) at the CA site and 0.134 $\mu g/cm^2$ (0.798%) at the WI site.
- **TRT 5 (Triamine II Optical):** The highest average TTR values (and percent of application rate) were 1.67 $\mu g/cm^2$ (10.1%) for MCPA, 1.01 $\mu g/cm^2$ (12.0%); corresponding TTR values (and percent application rate) at the WI site were 0.993 $\mu g/cm^2$ (5.98%) for MCPA.

A regression analysis was not performed on the data generated in this study due to the nature of the dissipation pattern (i.e. peak residues generally observed at the 8- or 12-hr sampling interval).