



## OFFICE OF CHEMICAL SAFETY AND POLLUTION PREVENTION

WASHINGTON, D.C. 20460

### MEMORANDUM

**DATE:** June 28, 2024

**SUBJECT:** **Mancozeb.** Second Revision: Occupational and Residential Exposure Assessment in Support of Registration Review.

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**FROM:** Destiny Carter, Biologist   
Risk Assessment Branch VII (RAB7)  
Health Effects Division (HED; 7509T)

**THRU:** Richard Fehir, Ph.D., Acting Branch Supervisor   
Risk Assessment Branch V/VII (RAB5/7)  
Health Effects Division (HED; 7509T)

**TO:** Benjamin Tweed, Review Manager  
Jordan Page, Team Leader  
Risk Management and Implementation Branch 3  
Pesticide Re-evaluation Division (PRD; 7508M)

The conclusions conveyed in this assessment were developed in full compliance with *EPA Scientific Integrity Policy for Transparent and Objective Science*, and EPA Scientific Integrity Program's *Approaches for Expressing and Resolving Differing Scientific Opinions*. The full text of *EPA Scientific Integrity Policy for Transparent and Objective Science*, as updated and approved by the Scientific Integrity Committee and EPA Science Advisor can be found here: [https://www.epa.gov/system/files/documents/2023-12/scientific\\_integrity\\_policy\\_2012\\_accessible.pdf](https://www.epa.gov/system/files/documents/2023-12/scientific_integrity_policy_2012_accessible.pdf). The full text of the EPA Scientific Integrity Program's *Approaches for Expressing and Resolving Differing Scientific Opinions* can be found here: <https://www.epa.gov/scientific-integrity/approaches-expressing-and-resolving-differing-scientific-opinions>.

## Introduction

As part of Registration Review, the Pesticide Re-Evaluation Division (PRD) of OPP has requested that the Health Effects Division (HED) evaluate the hazard and exposure data and conduct occupational and residential exposure assessments, as needed, to estimate the risk to human health that will result from the registered uses of mancozeb. Mancozeb has a metabolite/degradate, ethylenethiourea (ETU); therefore, this memorandum serves as HED's Registration Review occupational and residential exposure and risk assessment of mancozeb and mancozeb-derived ETU resulting from the registered uses of mancozeb.

This memo supersedes the previous memo (D465683, D. Carter, 02/10/2023) and incorporates minor changes in the occupational risk summary tables and the addition of wine and juice grapes to the occupational post-application assessment.

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; the Outdoor Residential Exposure Task Force (ORETF) database; the Agricultural Re-entry Task Force (ARTF) database; ExpoSAC Policies 14 and 15.2 (SOPs for Seed Treatment); the Residential SOPs (Lawns/Turf, Gardens/Trees), other registrant-submitted exposure monitoring studies (44958501, 44959601, 44959602, 44959603, 44961701). Some of these data are proprietary, and subject to the data protection provisions of the Federal Insecticide, Fungicide, and Rodenticide Act (FIFRA).

**Note:** This memorandum was originally reviewed by the Exposure Science Advisory Committee (ExpoSAC) on 10/15/2020.

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## 1.0 Executive Summary

Mancozeb (a coordination product of zinc ion and manganese ethylene bisdithiocarbamate) is a member of the ethylene bisdithiocarbamate (EBDC) group of fungicides, which includes the related active ingredients maneb and metiram. All of these compounds have a common metabolite/degradate, ethylenethiourea (ETU). Mancozeb is used as a broad-spectrum fungicide in agriculture, professional turf management, and horticulture.

### ***Use Profile***

Mancozeb is currently registered for foliar use on a wide variety of agricultural use sites including fruit trees, nuts, grains, herbs and spices, fruit and vegetable crops, as well as on ornamentals (professional, commercial, and/or production nurseries and greenhouses) and turfgrass (including golf courses and sod farms). Mancozeb is also registered for use as a seed treatment for a variety of crops. Mancozeb is formulated as a wettable powder (WP), dry flowable (DF), liquid, water soluble packet (WSP), and dust (D). It may be applied by handheld, ground, aerial and chemigation equipment. Seed is treated with commercial and on-farm equipment. All registered labels require handlers to wear baseline attire (i.e., long-sleeve shirt, long pants, shoes, and socks) with varying levels of personal protective equipment (PPE) including chemical resistant gloves, chemical resistant footwear, protective eyewear, and respirator. Mancozeb has numerous registered Section 3 labels along with multiple Special Local Need (SLN) labels which are also considered in this assessment. The restricted entry interval (REI) on all registered labels ranges from 12 to 48 hours.

There are no registered uses of ETU, however, exposure to ETU is included in this assessment as it is a metabolite/degradate of mancozeb.

### ***Exposure Profile***

Based on the registered use sites, there is the potential for occupational and residential/non-occupational exposures to both mancozeb and mancozeb-derived ETU. Short- (1 to 30 days) and intermediate-term (1 to 6 months) dermal and inhalation exposures are anticipated for occupational handlers and post-application re-entry workers. Short-term dermal (adults and children) post-application exposures are expected following professional applications to golf courses. Residential handler exposures, however, are not anticipated. Potential non-occupational (dermal for adults, dermal and incidental oral for children) exposures from spray drift are expected to be short-term only.

### ***Hazard Characterization***

#### **Mancozeb**

The subchronic oral toxicity study in rats was used for the selection of the mancozeb short-term incidental oral endpoint and is based on decreased T4 observed in female rats [lowest observed adverse effect level (LOAEL) = 20 mg/kg/day; no observed adverse effect level (NOAEL) = 10 mg/kg/day]. The level of concern (LOC) = 30 [3X to account for interspecies extrapolation (reduced based on toxicodynamic differences in human vs. rat thyroid function), 10X to account for intra-species variation, and 1X Food Quality Protection Act (FQPA) Safety Factor (SF)].

No systemic toxicity was observed in a dermal toxicity study in rats up to the limit dose (1,000 mg/kg/day). All developmental effects observed in the developmental neurotoxicity (DNT), developmental rat, and developmental rabbit studies, when converted to dermal equivalents using a dermal absorption factor (DAF) of 1%, resulted in dermal doses greater than the limit dose (1,500-12,800 mg/kg/day). Therefore, quantification of dermal risk is not required for mancozeb.

The subchronic inhalation study was selected for the short- and intermediate-term inhalation endpoint and was based on decreased T4 and thyroid hyperplasia in females [lowest observed adverse effect concentration (LOAEC) = 0.391 mg/L; no observed adverse effect concentration (NOAEC) = 0.095 mg/L]. Human-equivalent concentrations (HECs) and human-equivalent doses (HEDs) were calculated using the NOAEC and the regional deposited-dose ratio (RDDR) was based on the route-specific study. The LOC is 10 [1X to account for interspecies extrapolation (10X reduced to 1X due to the calculation of HECs accounting for *pharmacokinetic interspecies differences* and the *toxicodynamics interspecies differences* in the human vs. rat thyroid function), 10X to account for intra-species variation, and 1X FQPA SF].

### ETU

The short-term incidental oral, short- and intermediate-term inhalation, and short- and intermediate-term dermal endpoint was selected from an extended one-generation reproductive toxicity study (EOGRTS) in rats with a LOAEL of 0.2 mg/kg/day (a NOAEL was not established). The LOC = 300 (3X to account for interspecies extrapolation, 10X to account for intra-species variation, and 10X FQPA SF). A DAF of 6% was used for the dermal assessment.

### **Combining Endpoints**

**Mancozeb:** Since the points of departure (PODs) chosen to evaluate the incidental oral and inhalation MOEs do share a common toxicological endpoint, exposures via these routes could be combined; however, a dermal endpoint was not selected and is therefore not considered when combining routes.

**ETU:** Since the PODs chosen to evaluate the incidental oral, inhalation, and dermal exposure routes are based on the same study/share a common toxicological endpoint, exposures via these routes could be combined as appropriate. A total LOC of 300 was used since the LOCs for all three routes are the same; therefore, MOEs < 300 are of concern.

### **Cancer Quantification (Adults)**

ETU is classified as a Group B2 carcinogen with a  $Q_1^*$  (0.0601 (mg/kg/day)<sup>-1</sup>) based on liver tumors in female mice. Because mancozeb is known to be converted to ETU, it has also been classified as Group B2 for carcinogenicity, and the ETU cancer potency factor is used for assessing cancer risk associated from mancozeb uses. All cancer assessments are based only on the presence of ETU residues.

### **Residential Exposure and Risk Estimates**

#### *Residential Handler Exposure*

All registered mancozeb product labels require that handlers wear specific clothing (e.g., long sleeve shirt/long pants) and/or use PPE. Therefore, HED has made the assumption that these products are not for homeowner use and has not conducted a quantitative residential handler assessment.

### *Residential Post-Application Exposure and Risk*

There is the potential for post-application exposure to both mancozeb and mancozeb-derived ETU residues for individuals exposed as a result of being in an environment that has been previously treated with mancozeb. The quantitative exposure/risk assessment for residential post-application exposures is based on the registered golf course turf uses.

Mancozeb: No dermal POD was selected for mancozeb at this time; therefore, a quantitative post-application dermal assessment is not required.

ETU: A dermal residential post-application assessment was conducted for ETU. Results from a chemical-specific TTR study were incorporated into the post-application assessment for turf. The risk estimates indicate that the short-term dermal (adult and children 6 to <11 and children 11 to <16 years old) MOEs are not of concern (i.e., MOEs > LOC of 300) with MOEs ranging from 380 to 700.

### *Residential Post-Application Cancer Exposure and Risk*

ETU: The risk estimate for adult dermal post-application exposure to golf course turf is  $4 \times 10^{-7}$ .

### ***Non-Occupational Spray Drift***

Mancozeb: A quantitative non-occupational spray drift assessment for mancozeb was completed at this time. Although there is potential for both dermal (adults and children 1 to <2 years old) and incidental oral (children 1 to <2 years old only) exposure, only an incidental oral assessment was completed at this time since a dermal endpoint was not selected for mancozeb. Incidental oral (children 1 to <2 years old) risk estimates were calculated using available chemical-specific TTR data. For children, incidental oral screening-level risk estimates were not of concern at the field edge for all scenarios with MOEs ranging from 530 to 2,200 (LOC = 30).

ETU: A quantitative non-occupational spray drift assessment for ETU was completed at this time. Dermal (adult) and combined dermal and incidental oral (children 1 to <2 years old) risk estimates were calculated using available chemical-specific TTR data. For adults, dermal screening-level risk estimates were not of concern at the field edge with MOEs ranging from 420 to 1,700 (dermal LOC = 300). For children, combined dermal and incidental oral screening-level risk estimates were of concern at the field edge for most scenarios with MOEs ranging from 140 to 590 (LOC = 300). The distances required for exposures to reach the LOC of 300 range from 10 to 75 ft from the field edge.

### ***Occupational Exposure and Risk Estimates***

#### *Occupational Handler Exposure and Risk*

Based on the anticipated use patterns and current labeling, types of equipment and techniques that can potentially be used, occupational handler exposure to mancozeb and mancozeb-derived ETU is expected from the registered uses.

Mancozeb: Occupational handler non-cancer inhalation risk estimates for *foliar uses* indicate that the short- and intermediate-term inhalation MOEs are not of concern (i.e., MOEs  $\geq$  LOC of

10) with baseline attire (i.e., no respirator). Occupational handler inhalation MOEs range from 28 to 4,300,000.

Occupational handler non-cancer inhalation risk estimates for seed treatment uses indicate that the short- and intermediate-term inhalation MOEs are not of concern (i.e., MOEs  $\geq$  LOC of 10) for most scenarios at baseline (i.e., no respirator) for commercial and on-farm seed treatment. Occupational handler inhalation MOEs range from 11 to 94,000 for commercial seed treatment and 7.1 to 120,000 for on-farm seed treatment. One scenario (on-farm treating and planting potato seeds) is of concern at baseline (i.e., no respirator; MOE = 7.1) however, the scenario no longer of concern with the addition of a PF10 respirator (MOE = 71).

ETU: Occupational handler non-cancer combined (dermal and inhalation) risk estimates for foliar uses indicate that the short- and intermediate-term combined dermal and inhalation MOEs are of concern (i.e., MOEs < LOC of 300) at baseline (i.e., single layer ) plus label-specified PPE (i.e., gloves and no respirator) several scenarios with MOEs ranging from 3.7 to 110,000 (LOC = 300). Risk estimates considering maximum PPE (i.e., double/layer plus gloves and PF10 respirator and/or engineering controls (ECs; i.e., closed systems, enclosed cockpits, etc.), where applicable, are still of concern (i.e., MOEs < LOC of 300) for some scenarios with MOEs ranging from 28 to 280. Considering maximum PPE or engineering controls where applicable, the MOEs range from 28 to 110,000 (LOC = 300).

Occupational handler non-cancer combined (dermal and inhalation) risk estimates for seed treatment uses when using an open loading system for commercial seed treatment, do not reach acceptable combined (dermal + inhalation) MOEs (i.e., MOEs < 300) for 53 out of 60 scenarios assuming a worker is wearing a single layer of clothing, gloves and no respirator (i.e., the lowest level of clothing and PPE on some seed treatment labels). Risk estimates considering maximum PPE (i.e., double layer of clothing, gloves, and a PF10 respirator) are still of concern (i.e., MOEs < 300) for 49 scenarios (combined dermal + inhalation MOEs range from 3 to 31,000). For on-farm seed treatment, 16 out of 23 scenarios do not reach an acceptable combined (dermal + inhalation) MOE (i.e., MOEs < 300) at baseline (i.e., single layer and no respirator) plus label-specified PPE (i.e., gloves). Risk estimates considering maximum PPE (i.e., double layer of clothes, gloves, and a PF10 respirator) for 9 scenarios are still of concern with combined (dermal + inhalation) MOEs ranging from 4.9 to 100,000. A summary of the risk estimates can be found in Appendix F.

It should be noted that many labels reviewed for these particular seed treatment uses included requirements for treaters and/or multiple activity workers to wear a respirator; however, this piece of equipment is not listed on all labels (see Appendix D for label-specific PPE).

#### *Occupational Handler Cancer Exposure and Risk*

ETU: The risk estimates for the foliar uses of mancozeb ranged from  $7 \times 10^{-4}$  to  $4 \times 10^{-8}$  for private growers/handlers (10 days of exposure/year) and  $2 \times 10^{-3}$  to  $1 \times 10^{-7}$  for commercial handlers (30 days of exposure/year) with baseline attire (i.e., single layer and no respirator) plus label-specified PPE (i.e., gloves).

The risk estimates for the seed treatment uses of mancozeb ranged from  $5 \times 10^{-4}$  to  $3 \times 10^{-8}$  for private growers (10 days of exposure/year) and  $3 \times 10^{-4}$  to  $5 \times 10^{-8}$  with baseline attire (i.e., single layer and no respirator) plus label-specified PPE (i.e., gloves) for commercial applicators (30 days of exposure/year).

#### *Occupational Post-Application Dermal Exposure and Risk*

Occupational handler exposure to mancozeb and mancozeb-derived ETU is expected from the registered uses.

Mancozeb: Occupational post-application dermal exposures are anticipated for the registered uses of mancozeb; however, a quantitative dermal assessment was not conducted for mancozeb as no toxicological POD was selected.

ETU: Occupational post-application dermal exposures were assessed for ETU. For the occupational post-application assessment, chemical-specific TTR data and chemical-specific DFR data are available and were used to assess the metabolite, ETU. Risk estimates (i.e., MOEs) have been summarized in Section 8.2.2 by crop category due to the number of crops assessed; these categories include orchard crops, table and raisin grapes, field crops, and greenhouse crops.

- Risk estimates for representative orchard crops range from 37 to 4,300 on 0-DAT; risk estimates for 11 activities do not reach an acceptable MOE (i.e.,  $\text{MOE} > \text{LOC}$  of 300) on 0-DAT (days after treatment).
- Risk estimates for table and raisin grapes range from 16 to 1,300 on 0-DAT; risk estimates for 10 activities do not reach an acceptable MOE (i.e.,  $\text{MOE} > \text{LOC}$  of 300) on 0-DAT.
- Risk estimates for representative field crops range from 93 to 12,000 on 0-DAT; risk estimates for 23 activities do not reach an acceptable MOE (i.e.,  $\text{MOE} > \text{LOC}$  of 300) on 0-DAT.
- Risk estimates for greenhouse vegetables and greenhouse crops are not of concern (i.e.,  $\text{MOE} > \text{LOC}$  of 300) on 0-DAT. Risk estimates range from 490 to 3,600.
- Risk estimates for golf course and sod range from 150 to 1,700 on 0-DAT; risk estimates for 4 scenarios do not reach acceptable MOEs (i.e.,  $\text{MOE} > \text{LOC}$  of 300) on 0-DAT.

#### *Occupational Post-Application Inhalation Exposure and Risk*

Based on the Agency's current practices, a quantitative non-cancer occupational post-application inhalation exposure assessment was not performed for mancozeb or ETU 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 mancozeb.

#### *Occupational Post-Application Dermal Cancer Exposure and Risk*

ETU: Risk estimates for orchard crops range from  $7 \times 10^{-6}$  to  $5 \times 10^{-8}$ . Risk estimates for table and raisin grapes range from  $2 \times 10^{-5}$  to  $2 \times 10^{-7}$ . Risk estimates for all field crops range from  $1 \times 10^{-6}$  to  $1 \times 10^{-8}$ . Risk estimates for greenhouse vegetables and greenhouse crops range from  $3 \times 10^{-7}$  to

$5 \times 10^{-8}$ . Risk estimates for golf course and sod range from  $3 \times 10^{-7}$  to  $9 \times 10^{-7}$ . All risk estimates were calculated using a 30-day average dose.

### 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; the Outdoor Residential Exposure Task Force (ORETF) database; the ARTF database; ExpoSAC Policy 14 (SOPs for Seed Treatment); the Residential SOPs (Lawns/Turf, Gardens/Trees); and other registrant-submitted exposure monitoring studies (44958501, 44959601, 44959602, 44959603, 44961701), 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<sup>1</sup>.

## **2.0 Risk Assessment Conclusions and Recommendations**

Mancozeb: There were no risk estimates of concern with the exception of one scenario for seed treatment (MOE = 7.1, LOC = 10); this scenario is no longer of concern with the addition of a PF10 respirator (MOE = 71).

ETU: There were risk estimates of concern identified for non-occupational spray drift and occupational (handler and post-application) exposure for ETU.

### **2.1 Summary of Risk Estimates**

### **2.2 Label Recommendations**

HED notes that there were risk estimates of concern identified for occupational (handler and post-application) scenarios, as well as spray drift scenarios. HED recommends that the REIs on the labels be reviewed to address post-application risks of concern.

This risk assessment relies on a 2015 study by the Agricultural Handler Exposure Task Force (AHETF) that measured dermal and inhalation exposure for workers who mixed and loaded water-soluble packet pesticide products. Commensurate with the behaviors and practices represented by this data, labels for products formulated in water-soluble packaging should incorporate the Agency's revised instructions for proper mixing and loading of water-soluble packets. This revised language is aimed at ensuring that water-soluble packets are allowed to dissolve in water via mechanical agitation as intended and prevent them from being ruptured by streams of water or other means.

### **2.3 Data Deficiencies and Requirements**

None.

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<sup>1</sup> <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>

### 3.0 Hazard Characterization

#### Acute Toxicity

Mancozeb and ETU have low acute toxicity via the oral, dermal, and inhalation routes (Toxicity Category III-IV). Neither chemical is a dermal irritant nor a dermal sensitizer; both are classified as Toxicity III for eye irritation. Table 3.1 presents a summary of the acute toxicity information for mancozeb and Table 3.2 presents a summary of the acute toxicity information for ETU.

Guideline No.	Study Type	MRID(s)	Results	Toxicity Category
870.1100	Acute Oral (rat)	00142522	LD <sub>50</sub> > 5,000 mg/kg (M & F)	IV
870.1200	Acute Dermal (rabbit)	00142522	LD <sub>50</sub> > 5,000 mg/kg (M & F)	IV
870.1300	Acute Inhalation (rat)	00145996	LC <sub>50</sub> > 5.14 mg/L (M & F)	IV
870.2400	Primary Eye Irritation (rabbit)	00142522	Corneal involvement clearing in < 7 days	III
870.2500	Primary Skin Irritation (rabbit)	00142522	Slightly irritating	IV
870.2600	Dermal Sensitization (guinea pig)	40469501	Not a dermal sensitizer (Buehler)	N/A

Guideline No.	Study Type	MRID(s)	Results	Toxicity Category
870.1100	Acute Oral (mouse)	40552601	LD <sub>50</sub> > mg/kg (F)	III
870.1200	Acute Dermal (rat)	45888101	LD <sub>50</sub> > 2,000 mg/kg (M & F)	III
870.1300	Acute Inhalation (rat)	45888102	LC <sub>50</sub> > 10.4 mg/L (M & F)	IV
870.2400	Primary Eye Irritation (rabbit)	45888104	No irritation <sup>1</sup>	III
870.2500	Primary Skin Irritation (rabbit)	45888103	No irritation	IV
870.2600	Dermal Sensitization	N/A	N/A	N/A

<sup>1</sup> The primary eye irritation study was classified Unacceptable because a UV light was not observed with luorescein staining, however, another study is not required (D289726, M. Lewis, 4/30/2003)

#### Toxicological PODs Used for Risk Assessment

##### Mancozeb

*Incidental oral (short-term durations):* The subchronic oral toxicity study in rats (MRID 00261536) was used for the selection of the mancozeb incidental oral endpoint and is based on decreased T4 observed in female rats (LOAEL = 20 mg/kg/day; NOAEL = 10 mg/kg/day). This POD is protective of all adverse effects observed in the subchronic mouse, subchronic dog, subchronic neuropathology, DNT, developmental rat, and developmental rabbit studies. The subchronic dog study has a lower NOAEL (3 mg/kg/day) but this is an artifact of the dose selection for this study and the selected POD is protective of the adverse effects observed at 29 mg/kg/day in the subchronic dog study. The LOC is 30 (3X to account for interspecies extrapolation [reduced based on toxicodynamic differences in human vs. rat thyroid function], 10X to account for intra-species variation, and 1X FQPA SF).

*Dermal (short- and intermediate-term durations):* No systemic toxicity was observed in a dermal toxicity study in rats up to the limit dose (1,000 mg/kg/day). All developmental effects observed in the DNT, developmental rat, and developmental rabbit studies, when converted to dermal equivalents using a DAF of 1%, would result in dermal doses greater than the limit dose (1,500-12,800 mg/kg/day). Therefore, quantification of dermal risk is not required for mancozeb.

*Inhalation (short- and intermediate-term durations):* The subchronic inhalation study (MRID 00159471) with mancozeb was used for the selection of the short- and intermediate-term inhalation endpoint based on decreased T4 and thyroid hyperplasia in females (LOAEC = 0.391 mg/L; NOAEC = 0.095 mg/L). This POD is appropriate for the route and duration of exposure and is protective of all developmental effects observed in the database. HECs and HEDs were calculated using the NOAEC and the RDDR based on the route-specific study. The LOC is 10 [1X to account for interspecies extrapolation (10X reduced to 1X due to the calculation of HECs accounting for *pharmacokinetic interspecies differences* and the toxicodynamics interspecies differences in the human vs. rat thyroid function as discussed above), 10X to account for intra-species variation, and 1X FQPA SF].

### ETU

*Incidental oral (short-term durations):* The EOGRTS in rats (MRID 49140301) was used for the selection of the ETU incidental oral endpoint (LOAEL = 0.2 mg/kg/day; NOAEL not established). The POD is based on hypertrophy of the pars distalis of the pituitary in males [postnatal day (PND) 90], increased TSH in both sexes and decreases in T4 in PND 4 pups, and diffuse follicular cell hypertrophy of the thyroid in males (PND 90), and increased incidence of diffuse follicular cell hypertrophy of the thyroid and hypertrophy of the pars distalis of the pituitary in parental males. This POD is protective of all developmental and thyroid effects observed within the ETU database and open literature. The LOC is 300 (3X to account for interspecies extrapolation, 10X to account for intra-species variation, and 10X FQPA SF).

*Dermal (short- and intermediate-term durations) and Inhalation (short- and intermediate-term durations):* The dermal and inhalation PODs are based on the same EOGRTS used for the incidental oral route of exposure. For the dermal route of exposure, a DAF of 6% was used in the assessment. The LOC is 300 (3X to account for interspecies extrapolation, 10X to account for intra-species variation, and 10X FQPA SF).

ETU is classified as a Group B2 carcinogen with a  $Q_1^*$  ( $0.0601 \text{ (mg/kg/day)}^{-1}$ ) based on liver tumors in female mice. All cancer assessments are based only on the presence of ETU residues.

<b>Exposure/ Scenario</b>	<b>POD</b>	<b>Uncertainty/ FQPA Safety Factors</b>	<b>Level of Concern for Risk Assessment</b>	<b>Study and Toxicological Effects</b>
Incidental Oral Short-Term (1-30 days)	NOAEL = 10 mg/kg/day	UF <sub>A</sub> = 3X* UF <sub>H</sub> = 10X FQPA SF = 1X	Residential/ Non-occupational LOC = 30	<u>Subchronic Oral in Rats</u> (MRID 00261536) LOAEL = 20 mg/kg/day based on decreased T4 in females
Dermal Short-Term (1-30 days)	No systemic toxicity was observed in a dermal toxicity study in rats up to the limit dose (1,000 mg/kg/day). All developmental effects observed in the DNT, developmental rat, and developmental rabbit studies, when converted to dermal equivalents using a DAF = 1%, would result in dermal doses greater than the limit dose (1500-12,800 mg/kg/day). Therefore, quantification of dermal risks is not required for mancozeb.			

Exposure/ Scenario	POD	Uncertainty/ FQPA Safety Factors	Level of Concern for Risk Assessment	Study and Toxicological Effects
Inhalation Short-Term (1-30 days)	NOAEC = 0.095 mg/L See Table 3.5 for HEC/HED calculations	UF <sub>A</sub> = 1X** UF <sub>H</sub> = 10X FQPA SF = 1X	Residential LOC = 10	<u>Subchronic Inhalation in Rats (MRID 00159471)</u> LOAEC = 0.391 mg/L based on decreased T4 and thyroid hyperplasia in females
Cancer (oral, dermal, inhalation)	Classification: ETU is classified as a <b>Group B2</b> carcinogen with a linear low-dose extrapolation approach for human risk assessment based on liver tumors in female mice.			

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/NOAEC = no-observed adverse-effect level/concentration. LOAEL/LOAEC = lowest-observed adverse-effect level/concentration. UF = uncertainty factor. UF<sub>A</sub> = extrapolation from animal to human (interspecies). UF<sub>H</sub> = potential variation in sensitivity among members of the human population (intraspecies). FQPA SF = FQPA Safety Factor. MOE = margin of exposure. LOC = level of concern.

\* The interspecies uncertainty factor is reduced from 10X to 3X because of toxicodynamic differences in adult thyroid function that result in greater sensitivity of the adult rat to hypothyroidism compared to adult humans. The 3X toxicodynamics part of the 10X interspecies factor is removed in those assessments that are based on rat thyroid toxicity endpoints, leaving the 3X portion for toxicokinetic interspecies differences.

\*\* 10X reduced to 1X due to the calculation of HECs accounting for *pharmacokinetic interspecies differences* and the *toxicodynamics interspecies differences* in the human vs. rat thyroid function

Exposure/ Scenario	POD	Uncertainty Factors	Level of Concern for Risk Assessment	Study and Toxicological Effects
Dermal Short (1-30 days) and Intermediate-Term (1-6 months)	No systemic toxicity was observed in a dermal toxicity study in rats up to the limit dose (1,000 mg/kg/day). All developmental effects observed in the DNT, developmental rat, and developmental rabbit studies, when converted to dermal equivalents using a DAF = 1%, would result in dermal doses greater than the limit dose (1,500-12,800 mg/kg/day)			
Inhalation Short (1-30 days) and Intermediate-Term (1-6 months)	NOAEC = 0.095 mg/L See Table 3.5 for HEC/HED calculations	UF <sub>A</sub> = 1X** UF <sub>H</sub> = 10X	Occupational LOC = 10	<u>Subchronic Inhalation in Rats (MRID 00159471)</u> LOAEC = 0.391 mg/L based on decreased T4 and thyroid hyperplasia in females
Cancer (oral, dermal, inhalation)	Classification: ETU is classified as a <b>Group B2</b> carcinogen with a linear low-dose extrapolation approach for human risk assessment based on liver tumors in female mice.			

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/NOAEC = no-observed adverse-effect level/concentration. LOAEL/LOAEC = lowest-observed adverse-effect level/concentration. UF = uncertainty factor. UF<sub>A</sub> = extrapolation from animal to human (interspecies). UF<sub>H</sub> = potential variation in sensitivity among members of the human population (intraspecies). MOE = margin of exposure. LOC = level of concern.

\*\* 10X reduced to 1X due to the calculation of HECs accounting for *pharmacokinetic interspecies differences* and the *toxicodynamics interspecies differences* in the human vs. rat thyroid function

Population	Scenario	Toxicity Duration Adjustment <sup>1</sup>		HEC <sup>2</sup>		HED (mg/kg/day) <sup>3</sup>
		Daily	Weekly	mg/L	mg/m <sup>3</sup>	
Occupational	Handler	0.75	1	0.202	202	19.1

\* The inhalation values have been calculated based on the 2018 revised spreadsheets. The HED calculation has been revised to be based on the same breathing rate used to derive the HEC – resulting in a single HED as the toxicological point of departure. In terms of risk estimates, the effect of this error correction is not unidirectional – some previously-calculated risks will be higher, while some will be lower.

<sup>1</sup> Toxicity duration adjustment from 6 hours/day, 5 days/week in the route-specific inhalation study.

<sup>2</sup> HEC = human-equivalent concentration; HEC = rat POD (0.095 mg/L) x daily duration adjustment (0.75) x weekly daily duration adjustment (1) x RDDR (2.829).

<sup>3</sup> HED = human-equivalent dose; HED = HEC (mg/L) x human specific conversion factor (11.8 L/hr-kg) x respiratory tract to oral absorption ratio (1) x duration of daily exposure for activity (8 hrs/day).

Exposure/ Scenario	POD	Uncertainty/ FQPA Safety Factors	Level of Concern for Risk Assessment	Study and Toxicological Effects
Incidental Oral Short-Term (1-30 days)	LOAEL = 0.2 mg/kg/day	UF <sub>A</sub> = 3X* UF <sub>H</sub> = 10X FQPA SF = 10X	Residential/ Non-occupational LOC = 300	<u>EOGRTS in Rats</u> (MRID 49140301) LOAEL = 0.2 mg/kg/day based on hypertrophy of the pars distalis of the pituitary in males (PND 90), increased TSH in both sexes and decreases in T4 in PND 4 pups, and diffuse follicular cell hypertrophy of the thyroid in males (PND 90), and increased incidence of diffuse follicular cell hypertrophy of the thyroid and hypertrophy of the pars distalis of the pituitary in parental males
Dermal Short-Term (1-30 days)	LOAEL = 0.2 mg/kg/day DAF = 6%	UF <sub>A</sub> = 3X* UF <sub>H</sub> = 10X FQPA SF = 10X	Residential LOC = 300	<u>EOGRTS in Rats</u> (MRID 49140301) LOAEL = 0.2 mg/kg/day based on hypertrophy of the pars distalis of the pituitary in males (PND 90), increased TSH in both sexes and decreases in T4 in PND 4 pups, and diffuse follicular cell hypertrophy of the thyroid in males (PND 90), and increased incidence of diffuse follicular cell hypertrophy of the thyroid and hypertrophy of the pars distalis of the pituitary in parental males

Exposure/ Scenario	POD	Uncertainty/ FQPA Safety Factors	Level of Concern for Risk Assessment	Study and Toxicological Effects
Inhalation Short-Term (1-30 days)	LOAEL = 0.2 mg/kg/day	UF <sub>A</sub> = 3X* UF <sub>H</sub> = 10X FQPA SF = 10X	Residential LOC = 300	<u>EOGRTS in Rats</u> (MRID 49140301) LOAEL = 0.2 mg/kg/day based on hypertrophy of the pars distalis of the pituitary in males (PND 90), increased TSH in both sexes and decreases in T4 in PND 4 pups, and diffuse follicular cell hypertrophy of the thyroid in males (PND 90), and increased incidence of diffuse follicular cell hypertrophy of the thyroid and hypertrophy of the pars distalis of the pituitary in parental males
Cancer (oral, dermal, inhalation)	Classification: ETU is classified as a <b>Group B2</b> carcinogen with a linear low-dose extrapolation approach for human risk assessment based on liver tumors in female mice. Q1* = 6.01 x10 <sup>-2</sup> (mg/kg/day) <sup>-1</sup>			

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<sub>A</sub> = extrapolation from animal to human (interspecies). UF<sub>H</sub> = potential variation in sensitivity among members of the human population (intraspecies). UF<sub>L</sub> = use of a LOAEL to extrapolate a NOAEL. FQPA SF = FQPA Safety Factor. MOE = margin of exposure. LOC = level of concern.

\* The interspecies uncertainty factor is reduced from 10X to 3X because of toxicodynamic differences in adult thyroid function that result in greater sensitivity of the adult rat to hypothyroidism compared to adult humans. The 3X toxicodynamics part of the 10X interspecies factor is removed in those assessments that are based on rat thyroid toxicity endpoints, leaving the 3X portion for toxicokinetic interspecies differences.

Exposure/ Scenario	POD	Uncertainty Factors	Level of Concern for Risk Assessment	Study and Toxicological Effects
Dermal Short (1-30 days) and Intermediate-Term (1-6 months)	LOAEL = 0.2 mg/kg/day  DAF = 6%	UF <sub>A</sub> = 3X* UF <sub>H</sub> = 10X UF <sub>L</sub> = 10X	Occupational LOC = 300	<u>EOGRTS in Rats</u> (MRID 49140301) LOAEL = 0.2 mg/kg/day based on hypertrophy of the pars distalis of the pituitary in males (PND 90), increased TSH in both sexes and decreases in T4 in PND 4 pups, and diffuse follicular cell hypertrophy of the thyroid in males (PND 90), and increased incidence of diffuse follicular cell hypertrophy of the thyroid and hypertrophy of the pars distalis of the pituitary in parental males

Exposure/ Scenario	POD	Uncertainty Factors	Level of Concern for Risk Assessment	Study and Toxicological Effects
Inhalation Short (1-30 days) and Intermediate-Term (1-6 months)	LOAEL = 0.2 mg/kg/day	UF <sub>A</sub> = 3X* UF <sub>H</sub> = 10X UF <sub>L</sub> = 10X	Occupational LOC = 300	<u>EOGRTS in Rats</u> (MRID 49140301) LOAEL = 0.2 mg/kg/day based on hypertrophy of the pars distalis of the pituitary in males (PND 90), increased TSH in both sexes and decreases in T4 in PND 4 pups, and diffuse follicular cell hypertrophy of the thyroid in males (PND 90), and increased incidence of diffuse follicular cell hypertrophy of the thyroid and hypertrophy of the pars distalis of the pituitary in parental males
Cancer (oral, dermal, inhalation)	Classification: ETU is classified as a <b>Group B2</b> carcinogen with a linear low-dose extrapolation approach for human risk assessment based on liver tumors in female mice. Q1* = 6.01 x10 <sup>-2</sup> (mg/kg/day) <sup>-1</sup>			

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<sub>A</sub> = extrapolation from animal to human (interspecies). UF<sub>H</sub> = potential variation in sensitivity among members of the human population (intraspecies). UF<sub>L</sub> = use of a LOAEL to extrapolate a NOAEL. MOE = margin of exposure. LOC = level of concern.

\* The interspecies uncertainty factor is reduced from 10X to 3X because of toxicodynamic differences in adult thyroid function that result in greater sensitivity of the adult rat to hypothyroidism compared to adult humans. The 3X toxicodynamics part of the 10X interspecies factor is removed in those assessments that are based on rat thyroid toxicity endpoints, leaving the 3X portion for toxicokinetic interspecies differences.

### Absorption

Since no dermal POD was selected for mancozeb, a quantitative dermal risk assessment was not conducted for mancozeb. A DAF of 1% was selected for mancozeb based on two non-guideline studies in rats and was used in the assessment to determine dermally-absorbed mancozeb since ETU is metabolically produced after exposure to mancozeb. The absorbed mancozeb dermal dose was adjusted by a metabolic conversion factor<sup>2</sup> to determine the internal ETU dose as a result of *in-vivo* metabolism. A DAF of 6% was selected for the ETU exposure assessment and is based on human *in vitro* dermal penetration studies. For ETU, since no inhalation absorption data is available, toxicity by the inhalation route is considered to be equivalent to the estimated toxicity by the oral route of exposure. For mancozeb, a route-specific inhalation study was available.

### Body Weight

The standard body weight for the general population (80 kg) was used for all exposure scenarios covered in this risk assessment since the endpoints selected were not based on female-specific, developmental and/or fetal effects. For the assessment of the existing residential uses of mancozeb, the body weights used for children were 32 kg (6 to < 11 years old) and 57 kg (11 to < 16 years old).

<sup>2</sup> A. Kocialski, 09/12/1989. Memo: *Establishment of an in-vivo Metabolic Conversion Factor of 7.5% for all Ethylene Bis(Dithio) Carbamates (EBDCS) when Converting EBDCSs to Ethylene Thiourea (ETU) in- vivo.*

#### 4.0 Use and Exposure Profile

**Mancozeb:** Mancozeb is currently registered for foliar use on a wide variety of use sites including trees, nuts, grains, herbs and spices, fruit and vegetable crops, as well as ornamentals (professional, commercial, and/or production nurseries and greenhouses) and turfgrass (including golf courses and sod farms). Mancozeb is also registered for use as a seed treatment on a variety of crops. Mancozeb is formulated as a WP, DF, liquid, WSP, and D. It may be applied by handheld, ground, aerial and chemigation equipment. Seed is treated with commercial and on-farm equipment. Mancozeb has numerous registered labels along with multiple SLN labels which are also considered in this assessment. All registered labels require handlers to wear baseline attire (i.e., long-sleeve shirt, long pants, shoes, and socks) with varying level of PPE including: chemical resistant gloves, chemical resistant footwear, protective eyewear, respirator, and water-soluble packaging. The REI on all registered labels ranges from 12 to 48 hours.

A summary of the representative registered commercial end-use products and use sites for mancozeb are provided in Appendix A for the agricultural uses, non-agricultural and residential uses, and seed treatment uses of mancozeb. This summary has been compiled based primarily on the Biological and Economic Analysis Division's (BEAD's) Pesticide Label Use Summary (PLUS) Report (05/12/2020) and a review of several labels identified in that report.

**ETU<sup>3</sup>:** There are no registered uses of ETU, however, as already noted, exposure to ETU is included in this assessment as it is a metabolite/degradate of mancozeb. Exposure to ETU can occur via multiple sources:

1. For occupational handlers, mancozeb can produce ETU even prior to being applied because it can degrade in the water of spray solutions, then further degradation can occur during application. Therefore, factors to account for this degradation and the potential for direct ETU exposures were used for mixer/loaders and applicators.
2. ETU can also be found as an environmental degradate in post-application monitoring studies on agricultural crops and turf, so the Agency has also evaluated direct exposures to post-application workers and in residential settings as appropriate.
3. Finally, ETU can be formed in the human body via various metabolic pathways after the parent compound is absorbed. The contributions of this metabolic conversion are also considered in the assessment for ETU for both occupational handlers and occupational and residential post-application exposures.

To address the level of ETU exposures to those that prepare (i.e., mixer/loaders) and spray (i.e., applicators) mancozeb, the Agency required a series of tank mix stability studies that have been reviewed previously. There were 2 critical documents that the Agency considered when determining which conversion/degradation factors to use. These included:

- *Updated Occupational and Residential Exposure Assessment for EBDC Final Determination (HED #2-0015)*; Author: Steve Knott to Kathleen Martin, Special Review Manager, Special Review and

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<sup>3</sup> Description of the sources of ETU pulled from D286871, J. Dawson, 05/13/2003

Reregistration Division; Issued: December 10, 1991.

- *Ethylene Bisdithiocarbamates (EBDCs); Notice of Intent to Cancel and Conclusion of Special Review;* Federal Register Volume 57, No. 41; Published March 2, 1992.

In the 1991 document, ETU tank mix data for ETU conversion were presented along with characterization language for the tank mix stability studies used. The 1992 document reiterated those factors. The tank mix data are summarized below in Table 3.8 and the average values were used as ETU tank mix conversion factors to calculate the amount of ETU that would form during the mixing/loading or applying of mancozeb.

Exposure Scenario	Average amount of mancozeb converted to ETU (%) <sup>1</sup>	Range (%)
Mixing/Loading	0.1 (n = 60)	0.1 to 0.2
Applying	0.2 (n = 60)	0.03 to 0.3

<sup>1</sup>The values were used to calculate the amount of ETU that would be expected to be present based on degradation during the actual mixing or application process.  
<sup>2</sup>For seed treatment uses, HED has assumed 0.1% for mixing/loading, sewing, bagging, and planting scenarios and 0.2% for multiple activities and mixer/loader/applicator as a conservative measure due to higher exposures.

The characterization language included in the 1991 assessment pertaining to these tank mix studies should also be considered when interpreting the risk assessments for ETU. The 1991 document indicated "there were several issues of concern raised during the review of the data:

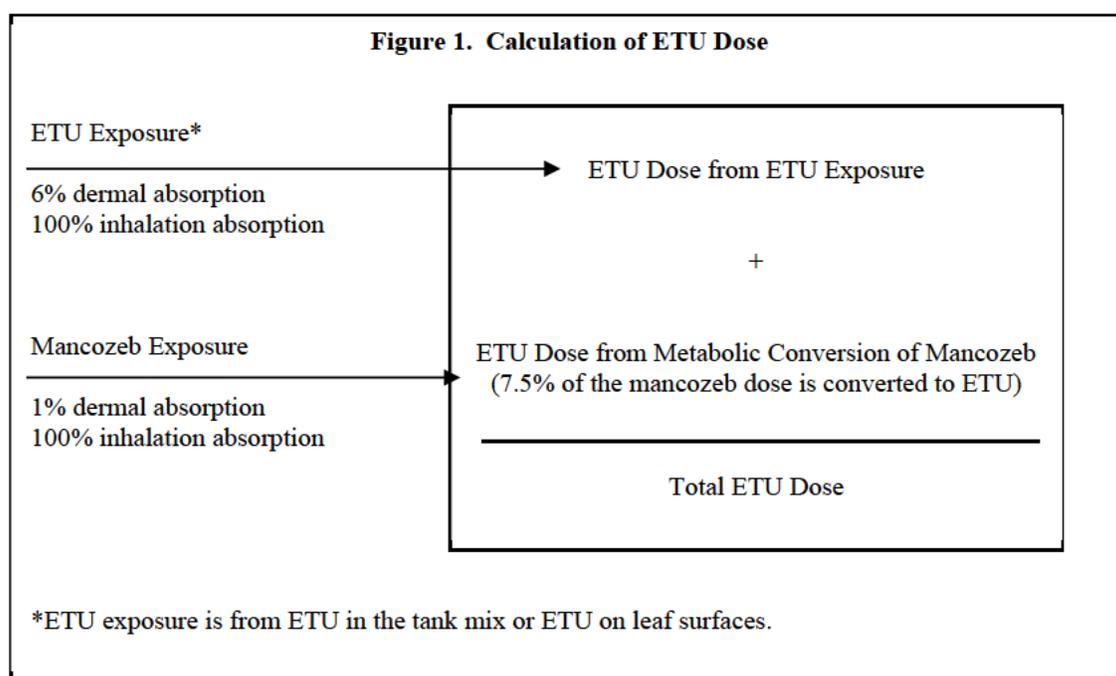
- The registrants failed to conduct an appropriate method recovery study during the tank mix stability testing. Therefore, a settlement agreement between the Agency and the EBDC registrants was designed so that a bridging study would be conducted to elevate the Agency's confidence in the data. Collecting the method recovery data in this manner is not as reliable as a concurrent method recovery study and it would be inappropriate to correct the original data for method analyte losses using the bridging study data. However, the 1991 review stated that this was a satisfactory alternative to complete rejection of the tank mix stability data.
- The bridging method recovery study was conducted by fortifying simulated EBDC tank mixes with ETU to a concentration of 1 percent. The samples in the original tank mix stability testing contained 0.5 percent ETU or less. Therefore, it would have been more appropriate to use a lower fortification level of ETU in the bridging study.
- It should also be noted that the data collected in the original tank mix stability testing may not be representative of the worst case for the formation of ETU in spray tank mixes under actual field conditions. More extreme conditions may exist during actual field use (i.e., temperatures in excess of 95°F). Therefore, the tank mix conversion data cannot be considered representative of the worst case."

The levels of ETU to which post-application workers are exposed or which may be present on residential turf was actually measured in a number of DFR and TTR dissipation studies. Those data were used by the Agency in its assessment of these scenarios.

The final source of ETU exposure is from metabolic conversion of parent mancozeb to ETU *in vivo*. A conversion factor of 7.5 percent was used which indicates that this amount of parent

mancozeb once absorbed is metabolically converted to ETU. This factor has been applied to all of the EBDCs in the past and has been applied in the same manner in this risk assessment. This factor is based on a September 12, 1989 memo from Albin Kocialski ((1) *Establishment of an in vivo Metabolic Conversion Factor of 7.5% for all Ethylene Bis(Dithio) Carbamates (EBDCS) When Converting EBDCs to Ethylene Thiourea (ETU) in vivo and (2) Recalculation of the Previously Considered 20% in vivo Conversion/Exposure Factor for EBDCs to ETU*).

In all of the risk assessments for different sources of ETU, the environmental contribution and the metabolic conversion of mancozeb to ETU has been added to calculate total ETU body burdens (see Figure 1 below). These body burden values are the basis of all of the assessments for ETU. Dose calculations can be found in risk estimate summary table footnotes and/or associated spreadsheets (sheet entitled, "Dose Calculations").



## 5.0 Residential Exposure and Risk Estimates

There are existing residential uses that have been reassessed in this document to reflect updates to HED's 2012 Residential SOPs<sup>4</sup> along with policy changes for body weight assumptions. The revision of residential exposures will impact the human health aggregate risk assessment for mancozeb and ETU.

### 5.1 Residential 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 tasks related to applications and that exposures can vary depending on the specifics of each task. Residential handlers are addressed

<sup>4</sup> Available: <http://www.epa.gov/pesticide-science-and-assessing-pesticide-risks/standard-operating-procedures-residential-pesticide>

somewhat differently by HED as homeowners are assumed to complete all elements of an application without use of any protective equipment.

All registered mancozeb product labels with residential use sites (e.g., turf, ornamentals, and cut flowers) require that handlers wear specific clothing (e.g., long sleeve shirt/long pants) and/or use PPE. Therefore, HED has made the assumption that these products are not for homeowner use and has not conducted a quantitative residential handler assessment.

## 5.2 Residential Post-application Exposure/Risk Estimates

There is the potential for post-application exposure to both mancozeb and mancozeb-derived ETU for individuals exposed as a result of being in an environment that has been previously treated with mancozeb. The quantitative exposure/risk assessment for residential post-application exposures is based on registered turf uses. Adults and children who come into contact with treated turf after application (e.g. golfing may receive dermal and/or incidental oral exposure to mancozeb and ETU residues).

No dermal POD was selected for mancozeb at this time; therefore, a quantitative post-application dermal assessment is not required.

A dermal POD was selected for ETU; therefore, a dermal post-application assessment for the metabolite was conducted.

The lifestages selected for each post-application scenario are based on an analysis provided as an Appendix in the 2012 Residential SOPs<sup>5</sup>. While not the only lifestage potentially exposed for these post-application scenarios, the lifestage that is included in the quantitative assessment is health-protective for the exposures and risk estimates for any other potentially exposed lifestage.

### Residential Post-application Exposure Data and Assumptions

A series of assumptions and exposure factors served as the basis for completing the residential post-application risk assessment. Each assumption and factor is detailed in the 2012 Residential SOPs<sup>Error!</sup>  
Bookmark not defined.

*Application Rate:* Maximum application rates can be found in Appendix D. For the residential post-application assessment for exposure to treated turf, a maximum application rate of 17.4 lb ai/A was used in the assessment.

*Exposure Duration:* Residential post-application exposure is expected to be short-term in duration.

*Turf Transferable Residues (TTR):* Chemical-specific TTR data for liquid formulations conducted in North Carolina, Pennsylvania, and California were submitted in 2000 and reviewed for mancozeb and ETU and were determined to be acceptable for risk assessment. Further information can be found in Appendix E, and summary tables have been provided below.

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<sup>5</sup> Available: <http://www.epa.gov/pesticide-science-and-assessing-pesticide-risks/standard-operating-procedures-residential-pesticide>

<b>5.2.1. Review of Dissipation of Turf Transferrable Residues of <u>Mancozeb</u> on Turf (MRID 44958501).</b>			
Statistic	CA site	NC site	PA site
Study Target Application Rate (lb ai/A)	11.3	16.1	10.5
Measured Average Day 0 Residue ( $\mu\text{g}/\text{cm}^2$ )	0.1883	0.1525	0.0774
Linear Regression Predicted Day 0 Residue ( $\mu\text{g}/\text{cm}^2$ )	<b>0.150</b>	0.101	0.049
Slope	-0.301	-0.234	-0.103
Half-Life (days)	2.3	3.0	6.7
R <sup>2</sup>	0.91	0.9266	0.7151

\* Residue used for assessment in **bold**.

<b>5.2.2. Review of Dissipation of Turf Transferrable Residues of <u>ETU</u> on Turf (MRID 44958501).<sup>1</sup></b>			
Statistic	CA site	NC site	PA site
Study Target Application Rate (lb ai/A)	11.3	16.1	10.5
Measured Average Day 0 Residue ( $\mu\text{g}/\text{cm}^2$ )	0.0020	0.0027	all < LOQ
Highest Measured Residue ( $\mu\text{g}/\text{cm}^2$ )	<b>0.0195</b> <b>(4 DAT)</b>	0.0026 (0.33 DAT)	all < LOQ
Highest Measured Residue - Adjusted ( $\mu\text{g}/\text{cm}^2$ )	<b>0.031<sup>2</sup></b>	-	-

<sup>1</sup> DAT = day after treatment. Highest residue across sites in **bold**.

<sup>2</sup> Highest measured residue ( $0.0195 \mu\text{g}/\text{cm}^2$ ) x Label Application Rate (17.4 lb ai/A) ÷ Study Application Rate (11.3 lb ai/A)

As a Tier 1 approach, HED typically uses the highest predicted Day 0 value from across the geographic sites monitored in the TTR study. For assessing dermal exposures from ETU residues, the highest measured residue for ETU at the CA site (due to fluctuating residues and residues below the level of quantification (LOQ) at other sites; see Appendix E) and mancozeb chemical-specific data (highest predicted day 0 residue across all three sites) were used which resulted in no risk estimates of concern.

#### Residential Post-application Non-Cancer Exposure and Risk Equations

The algorithms used to estimate residential post-application exposure and dose can be found in the 2012 Residential SOPs<sup>6</sup>.

#### Combining Exposure and Risk Estimates

**Mancozeb:** No dermal POD was selected for mancozeb at this time; therefore, a quantitative post-application dermal assessment is not required and there are no routes to combine.

**ETU:** Only the dermal exposure route is anticipated; therefore, only dermal exposures have been quantitatively assessed and there are no additional routes to combine.

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

Table 5.2.4 provides a summary of the estimated residential post-application exposures and risk estimates for ETU. Results from a chemical-specific TTR study were incorporated into the post-application assessment for turf. The risk estimates indicate that the short-term dermal (adult and children 6 to <11 and children 11 to <16 years old) MOEs are not of concern (i.e., MOEs > LOC of 300) with MOEs ranging from 380 to 700.

<sup>6</sup> <http://www.epa.gov/pesticide-science-and-assessing-pesticide-risks/standard-operating-procedures-residential-pesticide>

**Table 5.2.4. Residential Post-application Non-cancer Exposure and Risk Estimates - ETU.**

Lifestage	Post-application Exposure Scenario		Application Rate <sup>1</sup> (lb ai/A)	Foliar ETU Dose (mg/kg/day) <sup>3</sup>	Metabolized ETU Dose (mg/kg/day) <sup>4</sup>	Total ETU Dose (mg/kg/day) <sup>5</sup>	MOEs <sup>6</sup> (LOC = 300)
	Use Site	Route of Exposure					
CA TTR Predicted Day 0 Residue for mancozeb <sup>2</sup> : 0.15 ug/cm <sup>2</sup> ; Study App Rate for CA: 11.3 lb ai/A							
CA TTR Measured Day 0 Residue for ETU <sup>2</sup> : 0.0195 ug/cm <sup>2</sup> ; Study App Rate for CA: 11.3 lb ai/A							
Adult	Golfing	Dermal	17.4	0.0005	0.000046	0.0004	380
Child 6 < 11 years old				0.0003	0.000025	0.0003	700
Child 11to <16 years old				0.0004	0.000038	0.0002	460

1 Application rate based on registered labels; see Appendix D.

2 TTR based on MRID: 44958501. Residue data adjusted for differences in application rates.

3 Foliar ETU Dose (mg/kg/day) = Daily ETU Exposure (mg/kg/day) x ETU DAF (6%) ÷ BW (80 kg).

4 Metabolized ETU Dose (mg/kg/day) = Daily Mancozeb Exposure (mg/kg/day) x Mancozeb DAF (1%) x Metabolic Conversion Factor (7.5%) ÷ BW (80 kg).  
(Metabolized ETU = mancozeb metabolized to ETU internally, within the exposed individual.)

5 Total ETU Dose (mg/kg-day) = Foliar ETU Dose (mg/kg/day) + Metabolized ETU Dose (mg/kg/day).

6 MOE = POD (0.2 mg/kg/day) ÷ Total ETU Dose (mg/kg/day).

### Residential Post-application Dermal Cancer Exposure and Risk Estimate Equations

Post-application cancer risk estimates for adults were calculated using a linear low-dose extrapolation approach in which a lifetime average daily dose (LADD) is first calculated and then compared with a  $Q_1^*$  that has been calculated for ETU based on dose response data in the appropriate toxicology study ( $Q_1^* = 6.01 \times 10^{-2} \text{ (mg/kg/day)}^{-1}$ ). The algorithms used to estimate the LADD and cancer risk for residential post-application exposure can be found in Appendix B. Some of the inputs for the post-application cancer calculations may be different from the handler calculations and those are highlighted below.

#### *TTR Residues & Yearly Dermal Dose Estimates*

To determine the average total (combined ETU and mancozeb-derived ETU) dermal dose over the course of a year, HED calculated an average residue for both ETU (with ETU specific data) and mancozeb-derived ETU (with mancozeb specific data) by utilizing the highest residue for each scenario and inputting daily dissipation each day until the next application date. Then, using these average residues, an ETU dose and a mancozeb-derived ETU dose were calculated which was combined to determine the total ETU dose. The combined dose was used to determine the total cancer risk estimates. The following assumptions were incorporated into the assessment:

- Chemical-specific TTR dissipation rates were used for scenarios based on the information provided in the submitted TTR study. The re-treatments are based on registered labels and are provided in Appendix D.
- A dermal absorption factor of 1% was used to determine all dermal cancer estimates assessed for metabolized ETU.
- A dermal absorption factor of 6% was used to determine all dermal cancer estimates assessed for foliar ETU.
- Calculations of residues were as follows:

$$\text{Yearly average TTR (mg/kg/day)} = \frac{\sum \text{Day-0 TTR to Day-365 TTR}}{365}$$

when

Day X TTR =

$$\frac{\text{previous day TTR}}{\text{TTR} \times e^{[-(\text{daily dissipation rate}) \times (\text{number of days since the most recent application})]}}$$

Dermal LADD =

$$\text{yearly average dermal dose} \left( \frac{\text{m}}{\text{kg-day}} \right) \times \frac{\text{days of post-app exposure (365 days)}}{\text{days per year (365)}} \times \frac{\text{years of exposure (50 years)}}{\text{average lifespan (78 years)}}$$

Scenario	MRID	Starting Residue – corrected (µg/cm <sup>2</sup> )		Dissipation Rate (%)		# applic. /year <sup>1</sup>	RTI (days) <sup>1</sup>	365-day average (µg/cm <sup>2</sup> )	
		Mancozeb	ETU	Mancozeb	ETU			Mancozeb <sup>b</sup>	ETU
<b>Turf Transferable Residues</b>									
Turf	44958501 (CA: ETU and mancozeb)	0.231	0.031	26	1 <sup>2</sup>	5	10	0.014	0.0046

<sup>1</sup> Based on registered labels; See Appendix D

<sup>2</sup> Based on default assumptions, as ETU dissipation was indeterminable from the available TTR studies.

**Days Per Year of Exposure:**

- Golfing activities: 52 days (assuming 1 round per week over 365 days).

**Years Per Lifetime of Exposure:**

It is assumed that adults would be exposed for 50 years out of a 78 year lifespan.

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

Table 5.2.6 reflects the residential post-application dermal cancer risk estimate for ETU. The cancer risk estimates for adults from exposure to golf courses is  $4 \times 10^{-7}$ .

Lifestage	Post-application Exposure Scenario <sup>2</sup>	Dermal LADD (mg/kg/day) <sup>2</sup>	Total Dermal LADD (mg/kg/day) <sup>3</sup>	Cancer Risk Estimate <sup>4</sup>
CA TTR Predicted Day 0 Residue for mancozeb: 0.15 ug/cm <sup>2</sup> ; Study App Rate for CA: 11.3 ug/cm <sup>2</sup> CA TTR Predicted Day 0 Residue for ETU: 0.0195 ug/cm <sup>2</sup> (ETU); Study App Rate for CA: 11.3 ug/cm <sup>2</sup>				
Adult	Golfing	ETU	$6.9 \times 10^{-6}$	$4 \times 10^{-7}$
		Metabolized ETU	$2.5 \times 10^{-7}$	

1 Metabolized ETU = mancozeb metabolized to ETU internally, within the exposed individual.

2 Dermal LADD (mg/kg/day) = Dermal dose (mg/kg/day) × [Days per year of exposure (days/yr) ÷ 365 days/year] × [Years per lifetime of exposure (yrs) ÷ Lifetime expectancy (78 yrs)].

ETU dermal dose (mg/kg/day) = ETU Exposure (mg/kg/day) × ETU DAF (6%) ÷ body weight (80 kg)

Metabolized ETU dermal dose (mg/kg/day) = Mancozeb Exposure (mg/kg/day) × Mancozeb DAF (0.01) × Metabolic conversion (7.5%) ÷ body weight (80 kg)

3 Total LADD (mg/kg/day) = ETU Dermal LADD (mg/kg/day) + Metabolized ETU Dermal LADD (mg/kg/day).

4 Cancer risk estimates = Total LADD  $\times Q_1^*$ , where  $Q_1^* = 6.01 \times 10^{-2}$  (mg/kg/day)<sup>-1</sup>

### 5.3 Residential Risk Estimates for Use in Aggregate Assessment

Table 5.3.1 reflects the residential risk estimates that are recommended for use in the aggregate assessment for ETU.

- The recommended residential exposure for use in the adult, children 6 to <11 years old, and children 11 to < 16 years old aggregate assessments is dermal post-application exposure golfing.

Lifestage	Exposure Scenario	Dose (mg/kg/day) <sup>1</sup>							MOE <sup>2</sup> (Total ETU) (LOC = 300)			
		Dermal		Inhalation		Oral		Total	Dermal	Inhalation	Oral	Total
		ETU	Metabol. ETU	ETU	Metabol. ETU	ETU	Metabol. ETU					
Adult	Post-application exposure golfing	0.0005	0.00005	NA	NA	NA	NA	0.0005	380	NA	NA	380
Child 6 to < 11 years old		0.0003	0.00003	NA	NA	NA	NA	0.0004	700	NA	NA	700
Child 11 to <16 years old		0.0004	0.00004	NA	NA	NA	NA	0.0003	460	NA	NA	460

<sup>1</sup>Dose = the highest dose for each applicable lifestage of all residential scenarios assessed. Total = dermal + inhalation + incidental oral (where applicable).

<sup>2</sup>MOE = the MOEs associated with the highest residential doses. Total =  $1 \div (1/\text{Dermal MOE}) + (1/\text{Inhalation MOE}) + (1/\text{Incidental Oral MOE})$ , where applicable.

Table 5.3.3 reflects the residential cancer risk estimate that is recommended for use in the adult cancer aggregate assessment for ETU.

Lifestage	Exposure Scenario	Total Dermal LADD <sup>1</sup> (mg/kg/day)	Cancer Risk <sup>2</sup>
Adults	Golfing (dermal)	$6.9 \times 10^{-6}$	$4 \times 10^{-7}$

<sup>1</sup>Total LADD (mg/kg/day) = ETU Dermal LADD (mg/kg/day) + Metabolized ETU Dermal LADD (mg/kg/day).

<sup>2</sup>Cancer risk estimates = Total LADD  $\times Q_1^*$ , where  $Q_1^* = 6.01 \times 10^{-2}$  (mg/kg/day)<sup>-1</sup>

### 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.<sup>7</sup> Direct exposures would include inhalation of the spray plume or being sprayed directly. Rather, the exposures addressed here are thought to occur indirectly through contact with impacted areas, such as residential lawns, when compliant applications are conducted. Given this premise, exposures for children (1 to 2 years old) and adults who have contact with turf where residues are assumed to have deposited via spray drift thus resulting in an indirect exposure are the focus of this analysis analogous to how exposures to turf products are considered in risk assessment.

In order to evaluate the drift potential and associated risks, an approach based on drift modeling coupled with techniques used to evaluate residential uses of pesticides was utilized. Essentially, a residential turf assessment based on exposure to deposited residues has been completed to address drift from the agricultural applications of mancozeb and ETU. 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.<sup>8</sup> 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. Mancozeb (which degrades to ETU) is used on

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<sup>7</sup> This approach is consistent with the requirements of the EPA's Worker Protection Standard.

<sup>8</sup> <https://www.epa.gov/pesticide-science-and-assessing-pesticide-risks/models-pesticide-risk-assessment#AgDrift>

numerous crops and can be applied via airblast, 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 90<sup>th</sup> percentile results.
- **Orchard airblast applications** are based on the AgDrift option for Sparse (Young/Dormant) tree canopies.
- **Aerial applications** are based on the use of AgDrift Tier 1 aerial option for a fine to medium spray type and a series of other parameters which will be described in more detail below (e.g., wind vector assumed to be 10 mph in a downwind direction for entire application/drift event).<sup>9</sup>

Adult dermal and children (1 to <2 years old) dermal, incidental oral, and combined (dermal + oral) exposures resulting from spray drift residues were estimated using chemical-specific TTR data. For ETU, children (1 to <2 year old) dermal and incidental oral risk estimates were combined because the toxicity endpoint for each route of exposure was based on the same study and effect. Exposures were considered for 50 feet wide lawns where the nearest side of the property was directly adjoining the treated field (at field edge) and at varied distances up to 300 feet downwind of a treated field. Results are presented in Tables 6.1.1 – 6.1.2 and indicate that there are some risks of concern at the field edge. The algorithms used in the spray drift assessment are presented in Appendix C.

#### Combining Exposures/Risk Estimates:

*Mancozeb:* Dermal and incidental oral exposures are anticipated; however, there is no dermal endpoint selected. Therefore, only incidental oral exposures have been quantitatively assessed and there are no additional routes to combine.

*ETU:* Dermal and incidental oral risk estimates were combined for children in this assessment, since the toxicological effects for these exposure routes were similar.

#### Non-Occupational Spray Drift Exposure and Risk Estimate Equations

The algorithms used to estimate non-cancer exposure and dose for occupational handlers can be found in Appendix C.

#### Summary of Non-Occupational Spray Drift Exposure and Risk Estimates

Tables 6.1.1-6.1.2. present the non-occupational screening level spray drift exposure risk estimates for both dermal (adult and children 1 to < 2 years old) and combined dermal and incidental oral (children 1 to < 2 years old only) for mancozeb and ETU. Risk estimates were calculated using chemical-specific TTR data as outlined in Section 5.1. A full summary of risk estimates can be found in Appendix C, Tables C-6 to C-8.

*Mancozeb:* For children, incidental oral screening-level risk estimates were not of concern at the field edge for all scenarios with MOEs ranging from 530 to 2,200 (LOC = 30).

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<sup>9</sup> 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.

ETU: For adults, dermal screening-level risk estimates were not of concern at the field edge with MOEs ranging from 420 to 1,700 (dermal LOC = 300). For children, combined dermal and incidental oral screening-level risk estimates were of concern at the field edge for most scenarios with MOEs ranging from 140 to 590 (LOC = 300). The distances required for exposures to reach the LOC of 300 range from 10 to 75 ft from the field edge.

**Table 6.1.1. Screening Level Spray Drift Risk Estimates - Mancozeb.**

Representative Crop/Rate Group		Spray Type/ Nozzle Configuration	Application Rate <sup>a</sup> (lb ai/A)	Mancozeb Chemical- Specific Adjusted TTR (ug/cm <sup>2</sup> ) <sup>b</sup>	Incidental Oral MOE <sup>c</sup> (LOC = 30)
					At Edge
Almond (highest orchard/vineyard rate) and Cranberry (highest typical-acreage field crop rate)	Aerial	Fine to Medium	4.8	0.064	530
	Groundboom	High Boom Very fine to Fine			730
	Airblast (almond only)	Sparse			950
Barley (highest high-acreage field crop rate)	Aerial	Fine to Medium	1.6	0.024	1,600
	Groundboom	High Boom Very fine to Fine			2,200
Pear (SLN Labels Rate)	Groundboom	High Boom Very fine to Fine	6.38	0.085	550
	Airblast	Sparse			720

- a Application rate (lb ai/A) from registered labels. See Appendix D. For orchard/vineyard scenarios, there are 3 SLN labels (OR170001, WA090019, and WA120007) that allow a rate of 6.38 lb ai/A which exceeds the rate (4.8 lb ai/A) on Section 3 labels; therefore, the higher rate of 6.38 lb ai/A was included in this assessment as well.
- b Adjusted TTR (ug/cm<sup>2</sup>) = Label application rate (lb ai/A) x TTR from study (0.015 ug/cm<sup>2</sup>) ÷ Study application rate (11.3 lb ai/A)
- c MOEs at various distances from field edge = incidental POD (0.2 mg/kg/day) ÷ Dose (mg/kg/day), where the incidental oral 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 6.1.2. Screening Level Spray Drift Risk Estimates - ETU.**

Representative Crop/Rate Group		Spray Type/ Nozzle Configuration	Application Rate <sup>a</sup> (lb ai/A)	ETU Chemical-Specific Adjusted TTR (ug/cm <sup>2</sup> ) <sup>b</sup>	Mancozeb Chemical-Specific Adjusted TTR (ug/cm <sup>2</sup> ) <sup>b</sup>	Adult Dermal MOE <sup>c</sup> at Edge (LOC = 300)	Combined Child Dermal and Incidental Oral	
							MOE <sup>c</sup> at Edge (LOC = 300)	Distance at which MOE ≥ LOC (ft) [MOE]
Almond (highest orchard/vineyard rate) and Cranberry (highest typical- acreage field crop rate)	Aerial	Fine to Medium	4.8	0.008	0.064	420	140	75 [430]
	Groundboom	High Boom Very fine to Fine				580	200	10 [450]
	Airblast (almond only)	Sparse				760	260	10 [500]
Barley (highest high- acreage field crop rate)	Aerial	Fine to Medium	1.6	0.003	0.024	1300	430	NA
	Groundboom	High Boom Very fine to Fine				1700	590	NA
Pear (SLN Labels Rate)	Groundboom	High Boom Very fine to Fine	6.38	0.011	0.085	440	150	10 [340]
	Airblast	Sparse				570	190	10 [380]

- a Application rate (lb ai/A) from registered labels. See Appendix D. For orchard/vineyard scenarios, there are 3 SLN labels (OR170001, WA090019, and WA120007) that allow a rate of 6.38 lb ai/A which exceeds the rate (4.8 lb ai/A) on Section 3 labels; therefore, the higher rate of 6.38 lb ai/A was included in this assessment as well.
- b Adjusted TTR (ug/cm<sup>2</sup>) = Label application rate (lb ai/A) x TTR from study (0.0195 or 0.015 ug/cm<sup>2</sup>) ÷ Study application rate (11.3 lb ai/A)

c MOEs at various distances from field edge = incidental POD (0.2 mg/kg/day) ÷ Dose (mg/kg/day), where the incidental oral 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 FIFRA 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 mancozeb.

In addition to this screen, the Agency did a search to determine if available air monitoring data were available for mancozeb. Mancozeb was included in air monitoring conducted by the Pesticide Action Network North America (PANNA) in Minnesota from June 2006 to August 2008 on potatoes. In 2008, a total of 10 field samples were selected from two sites in Frazee and one site in Perham and were sent to a commercial lab for analysis. Mancozeb was not detected and because these sampling and analytical methods could not be used to detect ETU, it is uncertain whether the mancozeb results (non-detections) were due to degradation to ETU or whether overall mancozeb and ETU levels were not detectable. ([http://www.panna.org/sites/default/files/TechReport\\_MN-Drift\\_May2012-2.pdf](http://www.panna.org/sites/default/files/TechReport_MN-Drift_May2012-2.pdf)) However, given that all results from the available post-application or ambient air monitoring data for mancozeb were less than the limit of detection (LOD), a quantitative assessment has not been conducted.

## 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.

In addition to foliar uses, the following commercial and on-farm seed treatment worker activities are anticipated and have been assessed:

*Commercial Seed Treatment (CST) – Treating:* The CST-Treating scenario represents worker exposure while performing any combination of packaging, treating, or cleanout tasks, but not exclusively packaging or exclusively cleanout. This scenario includes several tasks, such as mixing and loading chemical, calibrating the treater, treating/coating the seed and sampling “wet” treated seed, that are

very critical to the CST process and generally involve just a few specially trained workers at each facility. Worker exposure associated with these scenario-specific tasks is predicted from the amount of active ingredient handled (AaiH).

The CST-Treating dataset represents use of closed loading systems. HED does not have data to quantify exposure from the use of an open loading system. Exposure may be higher with use of an open loading system; however, it should be noted that workers did other activities beyond just loading chemical (e.g., calibrating treater, treating/coating seed, sampling “wet” treated seed). If open loading systems are used for commercial seed treatment, HED anticipates that the risk estimates may be higher than what is presented here.

*CST - Packaging:* The CST-Packaging scenario represents worker exposure while performing one or more packaging tasks, but none of the treating or cleanout tasks. The packaging-related tasks identified include bagging, closing/sewing, tagging, stacking, and moving packaged seed via forklift. Worker exposure associated with these scenario-specific tasks is predicted from the amount of active ingredient handled (AaiH).

*CST - Cleaning:* The CST-Cleaning scenario represents worker exposure while performing cleanout-related tasks. Cleanout of seed-treating equipment is a task that can involve intensive contact with residue on equipment surfaces. Cleanout tasks might occupy a worker anywhere from a few minutes up to a large portion of the workday. The cleanout activity frequently involves intermittent cleanout tasks that occur for short durations periodically during a workday. If such workdays involve packaging and/or treating tasks as well, then total workday exposure would be described by the CST-Treating scenario. The CST-Cleaning scenario represents only those workers whose workday is exclusively devoted to cleanout activity. Worker exposure associated with these scenario-specific tasks is predicted from the active ingredient’s seed treatment application rate (AR) and the cleanout activity duration (AD) ( $AR \times AD$ ).

*CST-Loader/Planter:* The CST-Loader/Planter scenario consists of handling purchased bags of commercially treated seed, loading the treated seed to a hopper or similar planting equipment, and planting seed in fields. During planting, the planter typically performs other tasks in addition to operating the equipment by driving the tractor through the field, such as making sure that the seed is properly planted (e.g., by checking seed depth and making adjustments or repairs as needed) or leveling the seed in the hopper as needed. It would also include any ‘background’ exposure such as contact with contaminated surfaces or equipment in the workday environment. Even though this scenario is identified as involving enclosed cab tractors only, the assumption is that there would be no meaningful difference in planter exposure between open versus closed cabs, and therefore, the same dataset is used for both. This assumption is based on the likelihood that most worker exposure while planting treated seeds is coming from activities occurring outside the planter/tractor cab (i.e., maintenance activities). Worker exposure associated with these scenario-specific tasks is predicted from the amount of active ingredient handled.

*On-Farm Seed Treatment and Planting with Liquids (OFST/P-L):* The OFST/P-L scenario involves workers that operate any on-farm seed treating equipment, including mixing, loading and application of liquid pesticides to untreated seed, and any associated tasks such as maintaining the treating equipment, and then planting the treated seed. The OFST/P-L scenario represents treatment of seed at

or immediately before planting using manual-style treating/planting equipment such as hopper-box, planter-box, and slurry-boxes as well as using commercial-style treatment equipment. The workers often perform tasks other than treating and planting during the monitoring period, including cleaning auger (mixing) systems or planters after treatment was finished, shoveling treated seed into augers or directly into a planter, checking augers or spray nozzle operation, fixing auger problems, spreading untreated seed in seed hoppers, checking seed depth during planting, adjusting seed equipment, and removing dirt build-up on the planter. Worker exposure associated with these scenario-specific tasks is predicted from the amount of active ingredient handled.

*On-Farm Seed Treatment and Planting with Solids (OFST/P-S):* The OFST/P-S scenario involves workers that operate any on-farm seed treating equipment, including mixing, loading and application of solid pesticides to untreated seed, and any associated tasks such as maintaining the treating equipment and then planting the treated seed. The OFST/P-S scenario is representative of hopper box (or similar “at-plant” equipment) as well as commercial-style equipment used on-farm. The workers often perform tasks other than treating and planting during the monitoring period, including quickly cleaning the auger (mixing) system or planter after treatment was finished, shoveling treated seed into the auger or directly into a planter, fixing auger problems, spreading untreated seed in seed hopper, checking seed depth during planting, adjusting seed equipment, and removing dirt build-up on the planter. Worker exposure associated with these scenario-specific tasks is predicted from the amount of active ingredient handled.

The on-farm seed treatment datasets represent use of open loading systems. HED does not have data to quantify exposure from the use of a closed loading system. Exposure may be lower with use of a closed loading system; however, it should be noted that workers did other activities beyond just loading chemical (e.g., loading treated seed into planters and planting). If closed loading systems are used for on-farm seed treatment, HED anticipates that the risk estimates may be lower than what is presented here.

### Occupational Handler Exposure Data and Assumptions

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:* Maximum application rates can be found in Appendix D and the maximum application rate from the Section 3 labels for each occupational handler category was used in the assessment<sup>10</sup>. Maximum rates were also used for the cancer assessment; however, typical rates are likely more representative.

#### *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

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<sup>10</sup> For orchard/vineyard scenarios, there are 3 SLN labels (OR170001, WA090019, and WA120007) that allow a rate of 6.38 lb ai/A which exceeds the rate (4.8 lb ai/A) on Section 3 labels; however, since there were risks of concern identified at a rate of 4.8 lb ai/A, the higher rate of 6.38 lb ai/A was not included in this assessment because it would only result in higher risks.

AHETF database, the Outdoor Residential Exposure Task Force (ORETF) 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<sup>11</sup>”, 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<sup>12</sup> and/or HED’s Exposure Science Advisory Council Policy 14.1: Standard Operating Procedures for Seed Treatment<sup>13</sup>, which, along with additional information on seed treatment exposure assessment, can be found at the Agency website<sup>14</sup>.

*Area Treated or Amount Handled:* The inputs for area treated or amount handled for foliar treatment were based on information in ExpoSAC Policy 9.2 and are provided in Table D-2. For asparagus, caprifig, and potato dip treatments, which are not included in Policy 9.2, HED has made the assumption that the amount handled is 1,000 gallons of solution as a conservative approach. The inputs for amount of seed treated and the amount of seed planted were based on HED ExpoSAC Policy 15.2 and are provided in Table D-2.

*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 mancozeb and ETU, based on the registered uses, short- to intermediate-term exposures are expected; however, the PODs for short- and intermediate-term exposures are the same therefore, short-term exposure and risk estimates are protective of longer term durations.

*Personal Protective Equipment:* Estimates of dermal and inhalation exposure were calculated for various levels of PPE. Results are presented for “baseline” (i.e., single layer of clothing consisting of a long sleeved shirt, long pants, shoes plus socks, no respirator) plus label-specified PPE (i.e., gloves) or engineering controls where applicable, as well as baseline with various levels of PPE as necessary (e.g., double layer of clothing, respirator, etc). The mancozeb product labels direct mixers, loaders, applicators and other handlers to wear baseline attire as well as varying level of PPE including: chemical resistant gloves, chemical resistant footwear, protective eyewear, respirator. Refer to Appendix D for label-specific PPE.

Estimates of inhalation exposure and risk for occupational handler exposure assessments consider the reduction in exposure afforded by respirators. Typically, results are presented for “baseline,” defined as no respirator, and then, because they are the occupational standard in the pesticide industry, for

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<sup>11</sup> Available: Available: <https://www.epa.gov/sites/default/files/2021-05/documents/occupational-pesticide-handler-unit-exposure-surrogate-reference-table-may-2021.pdf>

<sup>12</sup> Available: <https://www.epa.gov/pesticide-science-and-assessing-pesticide-risks/occupational-pesticide-handler-exposure-data>

<sup>13</sup> [https://www.epa.gov/system/files/documents/2022-01/exposac-policy-14\\_seed-treatment-exposure-data.pdf](https://www.epa.gov/system/files/documents/2022-01/exposac-policy-14_seed-treatment-exposure-data.pdf)

<sup>14</sup> <https://www.epa.gov/pesticide-science-and-assessing-pesticide-risks/occupational-pesticide-exposure-seed-treatment>

half-face filtering facepiece or elastomeric respirators, quantified via application of their corresponding assigned protection factor (APF) of 10 (90% exposure reduction). This format, in some cases along with risk estimates for engineering controls, provides a variety of options for risk management decisions. This risk assessment presents potential inhalation risk estimates of concern when using a half-face filtering facepiece or elastomeric respirator (i.e., a PF10 respirator).

*Days per Year of Exposure:* To assess cancer risk, it is assumed that private growers would be exposed 10 days per year and commercial applicators would be exposed 30 days per year. The term “private grower” means that the grower or one of the workers would apply the pesticides to land owned or operated by the grower. Commercial applicators means the applicators are completing multiple applications for multiple clients.

*Years per Lifetime of Exposure:* It is assumed that handlers would be exposed for 35 years out of a 78 year lifespan.

*Lifetime Expectancy:* Life expectancy values are from the Exposure Factors Handbook 2011 Edition Table 18-1 (U.S. EPA, 2011). The table shows that the overall life expectancy is 78 years based on life expectancy data from 2007. In 2007, the average life expectancy for males was 75 years and 80 years for females. Based on the available data, the recommended value for use in cancer risk assessments is 78 years.

#### 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:

For mancozeb, a dermal POD was not selected; therefore, only inhalation risk estimates were calculated. For ETU, dermal and inhalation risk estimates were combined in this assessment, since the toxicological effects for these exposure routes were similar. Dermal and inhalation risk estimates were combined using the following formula:

$$\text{Total MOE} = \text{Point of Departure (mg/kg/day)} \div \text{Combined dermal + inhalation dose (mg/kg/day)}$$

#### Summary of Occupational Handler Non-Cancer Exposure and Risk Estimates

##### *Mancozeb:*

Occupational handler non-cancer inhalation risk estimates for foliar uses can be found in Appendix F (Table F-1) as well as the corresponding spreadsheet entitled “Mancozeb\_USEPA-OPP-HED\_Occupational Handler Exposure\_May2021.xlsx”. The risk estimates indicate that the short- and intermediate-term inhalation MOEs are not of concern (i.e., MOEs  $\geq$  LOC of 10) with baseline attire (i.e., no respirator). Occupational handler inhalation MOEs range from 28 to 4,300,000.

Occupational handler non-cancer inhalation risk estimates for seed treatment uses can be found in Appendix F (Table F-2) as well as the corresponding spreadsheet entitled “Mancozeb\_Seed\_Treatment\_USEPA OPP HED Occupational Handler Exposure Spreadsheet\_March2022.xlsx.” The risk estimates indicate that the short- and intermediate-term inhalation MOEs are not of concern for most

scenarios (i.e., MOEs  $\geq$  LOC of 10) at baseline (i.e., no respirator) for commercial and on-farm seed treatment. Occupational handler inhalation MOEs range from 11 to 94,000 for commercial seed treatment and 7.1 to 120,000 for on-farm seed treatment. One scenario (on-farm treating and planting potato seeds) is of concern at baseline (i.e., no respirator; MOE = 7.1) however, the scenario no longer of concern with the addition of a PF10 respirator (MOE = 71).

*ETU:*

Occupational handler non-cancer dermal and inhalation risk estimates for foliar uses can be found in Appendix F (Table F-3) as well as the corresponding spreadsheet entitled "ETU\_USEPA-OPP-HED\_Occupational Handler Exposure\_May2021.xlsx." The risk estimates indicate that the short- and intermediate-term combined dermal and inhalation MOEs are of concern (i.e., MOEs < LOC of 300) at baseline (i.e., single layer) plus label-specified PPE (i.e., gloves and no respirator) for several scenarios. Risk estimates considering maximum PPE (i.e., double/layer gloves and PF10 respirator) and/or engineering controls where applicable are still of concern (i.e., MOEs < LOC of 300) for some scenarios. Considering maximum PPE and/or engineering controls (i.e., closed systems, enclosed cockpits, etc.), the MOEs range from 28 to 110,000 (LOC = 300).

Occupational handler non-cancer dermal and inhalation risk estimates for seed treatment uses can be found in Appendix F (Table F-4) as well as the corresponding spreadsheet entitled "ETU\_USEPA-OPP-HED\_Seed Treatment and Planting Exposure\_March2022.xlsx". For commercial seed treatment, 53 out of 60 scenarios do not reach acceptable combined (dermal + inhalation) MOEs (i.e., MOEs < 300) assuming a worker is wearing a single layer of clothing, gloves and no respirator (the lowest level of clothing and PPE on some seed treatment labels). Risk estimates considering maximum PPE (i.e., double layer of clothing, gloves, and a PF10 respirator) are still of concern (i.e., MOEs < 300) for 49 scenarios (combined dermal + inhalation MOEs range from 3 to 31,000). For on-farm seed treatment, 16 out of 23 scenarios do not reach an acceptable combined (dermal + inhalation) MOE (i.e., MOEs < 300) at baseline (i.e., single layer and no respirator) plus label-specified PPE (i.e., gloves). Risk estimates considering maximum PPE (i.e., double layer of clothes, gloves, and a PF10 respirator) are still of concern for 9 scenarios with combined (dermal + inhalation) MOEs ranging from 4.9 to 100,000. A summary of the risk estimates has been provided in Appendix F.

It should be noted that many labels reviewed for these particular seed treatment uses included requirements for treaters and/or multiple activity workers to wear a respirator; however, this piece of equipment is not listed on all labels (see Appendix D for label-specific PPE).

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 to 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 during aerial applications (covering both airplanes and helicopters) of liquid formulations to pilots in enclosed cockpits (data from AHETF) and of granule formulations in enclosed cockpits (data from PHED). Therefore, risks to pilots are assessed using the engineering control (enclosed cockpits) and baseline attire (long-sleeve shirt, long pants, shoes, and socks); use of the data in this fashion is consistent with the Agency's Worker Protection Standard (WPS) stipulations for engineering controls, which says label-required PPE for applicators can be reduced when using an enclosed cockpit (40 CFR 170.240(d)(6)(iii)) as well as a provision regarding use of gloves for aerial applications (40 CFR 170.240(d)(6)(i)), which says 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.

WSP is an engineering control designed to prevent direct contact between users and the pesticide formulation in the packages, thereby reducing exposures. Users place the packets into water which dissolves the packaging, releasing the formulation into the water without exposure to significant dusts or liquid aerosols. The formulation within the packaging then mixes with the water so it can be applied as a liquid spray.

This risk assessment relies on a 2015 study by the AHETF that measured dermal and inhalation exposure for workers who mixed and loaded WSP pesticide products. This data is considered the most reliable data for conducting exposure and risk assessments for such products. During the initial stages of the AHETF field study, the AHETF identified work practices that the Agency agreed were inconsistent with the use of WSP as an engineering control intended to reduce exposures. For example, AHETF observed that some workers placed the packets in removable baskets hanging from the open tank hatch and used streams of water from hoses or overhead recirculation systems as agitation methods to break open and dissolve the packaging, resulting in visible and substantial amounts of airborne powder and/or liquid aerosol where the mixer/loader was working. Current labels, including those under consideration in this risk assessment, are silent or unclear on the use of baskets in the hatch and methods of agitation.

The AHETF, in consultation with the Agency, California's Department of Pesticide Regulation (CDPR) and the Canadian Pest Management Regulatory Agency (PMRA), drafted a set of best practices for handling and adding WSP to spray tanks. The resulting AHETF "mixing/loading water-soluble packet" dataset excludes monitoring results for activities inconsistent with these practices. Commensurate with use of the new dataset, the Agency has since formatted those best practices into label language to be included on all WSP pesticide products. This revised language ensures that users know WSP are intended to dissolve in water via mechanical agitation and not to rupture them via streams of water or other means. In order to achieve the intended benefits from proper use of WSP, these best practices should be incorporated directly on product labels, conflicting language should be removed from the same labels, and users should receive effective and timely training on the new procedures.

#### Occupational Handler Cancer Exposure and Risk Equations (ETU)

Cancer risk estimates were calculated using a linear low-dose extrapolation approach in which a LADD is first calculated and then compared with a  $Q_1^*$  that has been calculated for ETU based on dose response data in the appropriate toxicology study ( $Q_1^* = 6.01 \times 10^{-2} \text{ (mg/kg/day)}^{-1}$ ). Absorbed average daily dose (ADD) levels were used as the basis for calculating the LADD values. Dermal and inhalation ADD values were first added together to obtain combined ADD values. LADD values were then

calculated and compared to the  $Q_1^*$  to obtain cancer risk estimates. The algorithms used to estimate the LADD and cancer risk for occupational handlers can be found in Appendix B.

### Summary of Occupational Handler Cancer Exposure and Risk Estimates

#### *ETU:*

Occupational handler cancer combined dermal and inhalation risk estimates for foliar uses can be found in Appendix F (Table F-5) as well as the corresponding spreadsheet entitled “ETU\_USEPA-OPP-HED\_Occupational Handler Exposure\_May2021.xlsx”.

The cancer risk estimates for the foliar uses of mancozeb ranged from  $7 \times 10^{-4}$  to  $4 \times 10^{-8}$  for private growers/handlers (10 days of exposure/year) and  $2 \times 10^{-3}$  to  $1 \times 10^{-7}$  for commercial handlers (30 days of exposure/year) with baseline attire (i.e., single layer and no respirator) plus label-specified PPE (i.e., gloves).

Occupational handler cancer combined dermal and inhalation risk estimates for seed treatment uses can be found in Appendix F (Table F-6) as well as the corresponding spreadsheet entitled “ETU\_USEPA OPP HED\_Seed Treatment and Planting Exposure\_March2022.xlsx.”

The risk estimates for the seed treatment uses of mancozeb ranged from  $5 \times 10^{-4}$  to  $3 \times 10^{-8}$  for private growers (10 days of exposure/year) and  $3 \times 10^{-4}$  to  $5 \times 10^{-8}$  with baseline attire (i.e., single layer and no respirator) plus label-specified PPE (i.e., gloves) for commercial applicators (30 days of exposure/year).

## **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 FIFRA 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 mancozeb.

In addition, the Agency is continuing to evaluate the available post-application inhalation exposure data generated by the ARTF. 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 for mancozeb, 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.

Furthermore, for mancozeb, inhalation exposure during dusty mechanical activities such as shaking and mechanical harvesting is another potential source of post-application inhalation exposure. However, the airblast applicator scenario is believed to represent a reasonable worst case surrogate estimate of post-application inhalation exposure during these dusty mechanical harvesting activities. The non-cancer inhalation risk estimate for commercial airblast application is not of concern (i.e., MOE > LOC of 10).

The Worker Protection Standard for Agricultural Pesticides contains requirements for protecting workers from inhalation exposures during and after greenhouse applications through the use of ventilation requirements.[40 CFR 170.110, (3) (Restrictions associated with pesticide applications)].

A post-application inhalation exposure assessment is not required for seed treatment uses as exposure is expected to be negligible. Seed treatment assessments provide quantitative inhalation exposure assessments for seed treaters and secondary handlers (i.e., planters). It is expected that these exposure estimates would be protective of any potential low-level post-application inhalation exposure that could result from these types of applications.

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

*Mancozeb:* Occupational post-application dermal exposures are anticipated for the registered uses of mancozeb; however, a quantitative dermal assessment was not conducted as no dermal POD was selected.

*ETU:* Occupational post-application dermal exposures are assessed below for ETU as a dermal POD was selected.

**Seed Treatment:** Occupational post-application dermal exposures from seed treatment uses are not anticipated. The potential for post-application exposures following the planting of treated seeds is unlikely because sustained levels of contact with treated seed after it has been placed in the soil or other planting media would not be expected because no routine cultural practice required for the production of agricultural commodities involves such an activity, as defined in the no/low contact criteria in the Worker Protection Standard (WPS).

## Occupational Post-application Dermal Exposure Data and Assumptions

A series of assumptions and exposure factors served as the basis for completing the occupational post-application risk assessments. 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 ETU, based on the proposed use, short- to intermediate-term exposures are expected due to the use pattern.

*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<sup>15</sup>” which, along with additional information about the ARTF data, can be found at the Agency website<sup>16</sup>.

*Application Rate:* Maximum application rates can be found in Appendix D and the maximum application rate from the Section 3 labels for each occupational handler category was used in the assessment<sup>17</sup>. Maximum rates were also used for the cancer assessment; however, typical rates are likely more representative.

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

*Turf Transferable Residues:* Chemical-specific TTR data have been submitted for ETU. See Section 5.2 for a summary of the data; detailed information regarding this can be found in Appendix E.

*Dislodgeable Foliar Residues:* Eight chemical-specific DFR studies have been submitted for mancozeb, and these all have been reviewed (see Appendix E). Out of these eight studies, five studies have been found to be acceptable for risk assessment and are discussed in Appendix E. These studies include monitoring on grape (MRID 44959601), apple (MIRD 44959602), tomato (MRIDs 44959603 and 42560201), and greenhouse tomato (MRID 44961701) crops. These data have been used to assess post-application scenarios, where appropriate. For each study, as a first-tier approach, if data from multiple sites were available, the site that provided the highest residue value was used. For example, for the apple DFR study, the residue from the Washington site was used since that was the higher residue value. For the tomato DFR study, only the California site data were used since significant rainfall occurred at the Florida site. The first order kinetics for the available DFR data are presented in Table 8.2.2.1 below. Further details of these studies, including explanation around those studies not

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<sup>15</sup> Available: <https://www.epa.gov/pesticide-science-and-assessing-pesticide-risks/occupational-pesticide-handler-exposure-data>

<sup>16</sup> Available: <https://www.epa.gov/pesticide-science-and-assessing-pesticide-risks/occupational-pesticide-handler-exposure-data>

<sup>17</sup> For orchard/vineyard scenarios, there are 3 SLN labels (OR170001, WA090019, and WA120007) that allow a rate of 6.38 lb ai/A which exceeds the rate (4.8 lb ai/A) on Section 3 labels; however, since there were risks of concern identified at a rate of 4.8 lb ai/A, the higher rate of 6.38 lb ai/A was not included in this assessment because it would only result in higher risks.

found to be acceptable, can be found in Appendix E. Listed below are the appropriate data surrogates to assess registered crops.

- Apple DFR Data (MRID 44959602): used to assess post-application exposures for all orchard crops.
  - As a Tier 1 approach, HED typically uses the highest Day 0 residue from across the geographic sites monitored in the DFR study. When this approach results in risks of concern, the data can be refined by averaging. Based on current guidance related to combining data across different geographic sites, these DFR data would not be combined since they do not meet the criteria<sup>18</sup> for averaging across the two geographic sites. Additionally, as a refinement, temporal averaging was considered instead of only considering “day-of-application” exposures; however, since the PODs are based on an extended one-generation reproductive activity study, the data are not appropriate to time-average (the time-to-effect cannot be determined due to repeated dosing throughout the lifetime of the animal). Risk estimates have been presented for each site using both mancozeb and ETU data.
- Grape DFR Data (MRID 44959601): used to assess post-application exposures for grapes only
- Tomato DFR Data (MRID 44959603): used to assess post-application exposures for all other field crops
- Greenhouse Tomato DFR Data (MRID 44961701): used to assess post-application exposures for all other greenhouse vegetables and greenhouse crop (ornamentals)

8.2.2.1. Summary of Chemical Specific DFR 1 <sup>st</sup> Order Kinetics Data for Mancozeb and ETU.								
Study	Chemical	Sites	Study Application Rate (lb ai/A)	Measured Average Day 0 Residue ( $\mu\text{g}/\text{cm}^2$ )	Linear Regression Predicted Day 0 Residue ( $\mu\text{g}/\text{cm}^2$ )	Slope	Half-Life (days)	R <sup>2</sup>
Dissipation of Dislodgeable Foliar of Mancozeb Applied to <i>Grapes</i> - 1999 (MRID 44959601)	Mancozeb	CA*	1.95	4.5360	4.422	-0.039	18.0	0.90
	ETU			0.0544	0.018	-0.067	10.4	0.64
Dissipation of Dislodgeable Foliar Residues of Mancozeb Applied to <i>Apples</i> - 1999 (MRID 44958501)	Mancozeb	NY*	5.0	15.8614	13.303	-0.074	9.4	0.96
	ETU			0.224	0.094	-0.090	7.7	0.78
	Mancozeb	WA*		16.4544	13.732	-0.032	13.7	0.91
	ETU			0.0529	0.045	-0.024	28.7	0.81
Dissipation of Dislodgeable Foliar Residues of Mancozeb Applied to <i>Tomatoes</i> - 1999 (MRID 44959603)	Mancozeb	FL	2.5	7.4	3.535	-0.142	4.9	0.90
	ETU			0.0023	0.002	-0.015	46.8	0.007
	Mancozeb	CA*	1.7	6.77	3.644	-0.110	6.3	0.94
	ETU			0.0092	0.011	-0.191	3.6	0.91

<sup>18</sup> Criteria for Tier 1 “spatial” averaging: predicted initial concentrations ( $C_0$ ) are within approximately 2X and predicted dissipation slopes ( $k$ ) are within approximately 4X across the study sites. The ETU data does not meet this requirement.

8.2.2.1. Summary of Chemical Specific DFR 1 <sup>st</sup> Order Kinetics Data for Mancozeb and ETU.								
Study	Chemical	Sites	Study Application Rate (lb ai/A)	Measured Average Day 0 Residue ( $\mu\text{g}/\text{cm}^2$ )	Linear Regression Predicted Day 0 Residue ( $\mu\text{g}/\text{cm}^2$ )	Slope	Half-Life (days)	R <sup>2</sup>
Dissipation of dislodgeable Foliar Residues of Mancozeb Applied to <i>Greenhouse Tomatoes</i> - 1999 (MRID 44961701)	Mancozeb	NC*	2.3	5.2917	3.718	-0.070	9.8	0.91
	ETU			0.0128	0.010	-0.036	19.2	0.60

\* Site was used for Risk Assessment; see Appendix E for further details.

**Days per Year of Exposure:** HED assumes that post-application workers would be exposed 30 days per year.

**Years per Lifetime of Exposure:** HED assumes that post-application workers would be exposed for 35 years out of a 78 year lifespan.

**Lifetime Expectancy:** Based on available data from EPA's Exposure Factors Handbook 2011 Edition, the recommended lifespan for use in cancer risk assessments is 78 years. Life expectancy values are derived from the Exposure Factors Handbook 2011 Edition Table 18-1 (U.S. EPA, 2011). The table shows that the overall life expectancy is 78 years based on life expectancy data from 2007. In 2007, the average life expectancy for males was 75 years and 80 years for females.

#### 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

Occupational post-application dermal risk estimates can be found in Appendix F (Table F-7) as well as the corresponding spreadsheet entitled "ETU\_USEPA-OPP-HED\_ExpoSAC Policy 3\_Occupational Pesticide Re-entry Exposure Calculator\_March2021\_w-cancer.xlsx".

Risk estimates for representative orchard crops (sheets entitled, "Apple Tot Expo-Risk-REI Ca NY" and "Apple Total Expo-Risk-REI Ca WA") range from 37 to 4,300 on 0-DAT; risk estimates for 11 activities do not reach an acceptable MOE (i.e., MOE > LOC of 300) on 0-DAT; these activities are summarized in Table 8.2.2.2.

Crop	Activity	WA Chemical-Specific Data		NY Chemical-Specific Data	
		MOE on 0-DAT	DAT at which MOE ≥ LOC [MOE]	MOE on 0-DAT	DAT at which MOE ≥ LOC [MOE]
Almond	Scouting	280	3 [300]	230	4 [320]
Pome Fruits (apple, crabapple, pear, quince) <sup>a</sup>	Scouting	280	3 [300]	230	4 [320]
	Hand Harvesting	110	32 [300]	95	15 [310]
	Hand Pruning	280	3 [300]	230	4 [320]
	Training	280	3 [300]	230	4 [320]
	Thinning Fruit, Hand	45	>35 [130]	37	27 [310]
Christmas Trees	Hand Set Irrigation	130	29 [300]	110	13 [300]
	Hand Harvesting	170	18 [300]	140	10 [320]
Subtropical/Tropical Fruit (mango, papaya, sugar apple, cherimoya, atemoya, custard apple, sweetsop, , canistel, mamey sapote, sapodilla, white sapote, banana, plantain, sweetsop, star apple [caimito]) <sup>b</sup>	Hand Harvesting	280	3 [300]	230	4 [310]
	Thinning Fruit, Hand	110	34 [300]	89	16 [320]

a. Surrogate crop assessed = apple

b. Surrogate crop assessed = mango and papaya

Risk estimates for table and raisin grapes (sheet entitled, “Grape Total Expo-Risk-REI Cal”) range from 16 to 1,300 on 0-DAT; risk estimates for 10 activities do not reach an acceptable MOE (i.e., MOE > LOC of 300) on 0-DAT; these activities are summarized in Table 8.2.2.3.

Crop	Activity	MOE on 0-DAT	DAT at which MOE ≥ LOC [MOE]
Grapes, Table	Girdling	16	>30 [56]
	Hand Set Irrigation	160	15 [300]
	Turning	16	>30 [56]
	Tying/Training	55	>30 [190]
	Hand Harvesting	55	>30 [190]
	Leaf Pulling	55	>30 [190]
Grapes, Raisin	Hand Set Irrigation	160	15 [300]
	Tying/Training	55	>30 [190]
	Hand Harvesting	55	>30 [190]
	Leaf Pulling	55	>30 [190]
Grapes, Wine/Juice	Hand Set Irrigation	160	15 [300]

Risk estimates for representative field crops (sheet entitled, “Tomato Tot Expo-Risk-REI-Ca”) range from 93 to 12,000 on 0-DAT; risk estimates for 23 activities do not reach an acceptable MOE (i.e., MOE > LOC of 300) on 0-DAT; these activities are summarized in Table 8.2.2.4.

**Table 8.2.2.4. Summary of Occupational Post-Application Non-Cancer Risks of Concern – Field Crops**

Crop	Activity (crop height/foilage density)	MOE on 0-DAT	DAT at which MOE ≥ LOC [MOE]
Banana	Hand Harvesting	290	1 [330]
Broccoli	Scouting	150	6 [310]
	Hand Harvesting	150	6 [310]
Cabbage	Hand Weeding	150	6 [310]
	Hand Weeding	150	6 [310]
Corn, sweet, grain	Hand Harvesting	93	10 [320]
Cranberry	Hand Harvesting (raking)	190	4 [310]
	Scouting	190	4 [310]
Cucurbit Vegetables (cantaloupe, cucumber, gourd, pumpkin, squash, melons, and squash) <sup>a</sup>	Hand Set Irrigation	220	3 [320]
Lettuce, leaf	Hand Set Irrigation	280	1 [310]
Onion, bulb, garlic, shallot, bulb <sup>b</sup>	Hand Set Irrigation	220	3 [320]
	Scouting	290	1 [330]
	Hand Weeding (low/full)	98	9 [300]
	Hand Weeding (low/min)	220	3 [320]
Onion, green, leek, shallot, fresh leaves <sup>c</sup>	Hand Harvesting	290	1 [330]
	Hand Set Irrigation	220	3 [320]
	Scouting	290	1 [330]
	Hand Weeding (low/full)	98	9 [300]
	Hand Weeding (low/min)	290	1 [330]
Pepper, bell	Hand Set Irrigation	220	3 [320]
Pepper, chili	Hand Set Irrigation	220	3 [320]
Tobacco	Hand Set Irrigation	260	1 [300]
Tomato	Hand Set Irrigation	220	3 [320]

- a. Surrogate crop assessed = cucumber  
b. Surrogate crop assessed = onion, bulb  
c. Surrogate crop assessed = onion, green

Risk estimates for greenhouse vegetables and greenhouse crops (sheet entitled, “GH Total Tomato Expo-Risk-REI-C”) are not of concern (i.e., MOE > LOC of 300) on 0-DAT. Risk estimates range from 490 to 3,600.

Risk estimates for golf course and sod (sheets entitled, “CA TTR Tota Expo-Risk-REI Calcu, PA TTR Tota Expo-Risk-REI C, and NC TTR Tota Expo-Risk-REI C”) range from 150 to 1,700 on 0-DAT; risk estimates for 4 scenarios do not reach acceptable MOEs (i.e., MOE > LOC of 300) on 0-DAT; these activities are summarized in Table 8.2.2.5.

**Table 8.2.2.5. Summary of Occupational Post-Application Non-Cancer Risks of Concern – Golf Course and Sod**

Crop	Activity	MOE on 0-DAT	DAT at which MOE ≥ LOC [MOE]
		CA Chemical-Specific Data	
Golf Course	Maintenance	270	1 [300]
Sod	Maintenance	150	7 [330]
	Harvesting, Slab	150	7 [330]
	Transplanting/Planting	150	7 [330]

While the quantitative occupational exposure assessment includes risk estimates for table grape cane turning and girdling, information provided by USDA, university extension agents, industry specialists, and grower groups<sup>1</sup> indicate that the prevalence and exposure potential of both practices has decreased as grape trellis systems have changed over time. Cane turning (also referred to as cane “moving” or “throwing”) is a part of trellis or canopy management by which canes are turned/moved/thrown by hand from one side of the trellis to the other in order to promote grape productivity by altering the canopy’s airflow and exposure to sunlight. Girdling, a highly specialized skill, involves scoring a cut into the vine bark approximately ¼” deep around the entire circumference, and 8 to 12 inches above the ground which alters nutrient transport and can result in larger grapes. The Agency uses two studies, one from the late 1980s<sup>2</sup> and the other from the early 1990s<sup>3</sup>, to estimate workers’ pesticide exposure potential while turning and girdling in grape vineyards. The studies indicate that both cane turning and girdling have the potential for high exposure following pesticide applications via extensive contact with foliar residue (quantitatively represented by a transfer coefficient of 19,300 cm<sup>2</sup>/hr).

Based on information provided to the Agency<sup>4</sup>, open-gable/Y-trellis systems have increasingly replaced older/T-trellis systems, and these modern Y-trellis systems no longer require turning or throwing canes to manage trellis canopies and crop growth; therefore, these post-application scenarios (i.e., grape turning) are not applicable when modern Y-trellis systems are in place. However, despite the large majority of table grapes being grown with more modern Y-trellis systems (approximately 85% of table grape growers), the Agency’s assessment and risk estimates remain relevant for the smaller fraction of growers who do not use the modern Y-trellis system who’s workers may still perform turning or throwing cane activities for canopy management.

Additionally, not only do the modern Y-trellis systems reduce the need to girdle grape canes to promote larger berry size, in comparison to the older trellis systems represented by the studies that EPA uses for assessing risk during girdling, photographs and videos provided to EPA suggest that modern Y-trellis systems, with their more open, raised canopies and less draping of foliage, also reduce the potential for contact with pesticide residues during girdling. Grape grower groups also noted that a key objective of table grape breeding programs is to develop varieties that do not need to be girdled due to their large natural berry size (Gabler, 2020<sup>5</sup>; Vasquez, 2020<sup>6</sup>). Therefore, while the high exposure potential represented by EPA’s current girdling assessment still accurately represent the smaller fraction of growers still using older T-trellis systems, workers conducting girdling activities under the modern/Y-trellis systems are expected to have lower exposure potential in line with that of pruning, tying/training, or hand harvesting activities.

Overall, risk estimates and any corresponding REIs or other risk management actions for turning and girdling grapes should be considered in light of the differing trellis systems. For older T-trellis systems, the cane turning and girdling activity transfer coefficient (TC) of 19,300 cm<sup>2</sup>/hr is relevant as currently established in risk assessment. However, for the modern Y-trellis systems, turning activities are no longer considered a relevant activity for exposure assessment. Lastly, for modern Y-trellis system girdling activities, a reduced exposure potential is anticipated. While no new monitoring data are currently available, based on a transfer coefficient in line with that of pruning, tying/training, or hand harvesting activities with a TC of 5,500 cm<sup>2</sup>/hr may be more representative of actual exposures. The Agency will continue to monitor all available information sources to best assess and characterize the exposure potential for workers in grape agricultural settings.

### Restricted Entry Interval

Mancozeb and ETU are classified as Toxicity Categories IV and III, respectively, via the dermal route and Toxicity Category IV for skin irritation potential. Neither is a skin sensitizer. Mancozeb does not have a dermal POD and therefore, a quantitative dermal post-application assessment was not conducted; however, an assessment was conducted for its metabolite, ETU. Short- and intermediate-term post-application risk estimates were of concern on day 0 (12 hours following application) for most activities for ETU with implications for re-entry extending out to almost 30 days for some activities. HED recommends that increased REIs be considered on the labels to address those concerns.

### Occupational Post-application Cancer Dermal Exposure and Risk Equations

As was done for occupational handlers, post-application cancer risk estimates were calculated using a linear low-dose extrapolation approach in which a LADD is first calculated and then compared with a  $Q_1^*$  that has been calculated for ETU based on dose response data in the appropriate toxicology study ( $Q_1^* = 6.01 \times 10^{-2} \text{ (mg/kg/day)}^{-1}$ ). The algorithms used to estimate the LADD and cancer risk for occupational workers can be found in Appendix B.

### Occupational Post-application Cancer Dermal Risk Estimates

Occupational post-application cancer dermal risk estimates can be found in the corresponding spreadsheet entitled "ETU\_USEPA-OPP-HED\_ExpoSAC Policy 3\_Occupational Pesticide Re-entry Exposure Calculator\_March2021\_w-cancer.xlsx". A summary of risk estimates can be found in Appendix F. Risk estimates were calculated using a 30-day average dose.

- Risk estimates for orchard crops range from  $7 \times 10^{-6}$  to  $5 \times 10^{-8}$ .
- Risk estimates for table and raisin grapes range from  $2 \times 10^{-5}$  to  $2 \times 10^{-7}$ .
- Risk estimates for all field crops range from  $1 \times 10^{-6}$  to  $1 \times 10^{-8}$ .
- Risk estimates for greenhouse vegetables and greenhouse crops range from  $3 \times 10^{-7}$  to  $5 \times 10^{-8}$ .
- Risk estimates for golf course and sod range from  $3 \times 10^{-7}$  to  $9 \times 10^{-7}$ .

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

### Residential Non-cancer Post-application Algorithms

#### *Turf/Golfing*

##### Post-application Dermal Exposure Algorithm - Golfing

Exposure resulting from contacting previously treated turf while golfing is calculated as follows:

$$E = TTR_t * CF1 * TC * ET$$

where:

E = exposure (mg/day);

TTR<sub>t</sub> = turf transferable residue on day "t" (µg/cm<sup>2</sup>);

CF1 = weight unit conversion factor (0.001 mg/µg);

TC = transfer coefficient (cm<sup>2</sup>/hr); and

ET = exposure time (hr/day).

and

$$TTR_t = AR * F * (1 - F_D)^t * CF2 * CF3$$

where:

TTR<sub>t</sub> = turf transferable residue on day "t" (µg/cm<sup>2</sup>);

AR = application rate (lbs ai/ft<sup>2</sup> or lb ai/acre);

F = fraction of ai retained on turf (unitless);

F<sub>D</sub> = fraction of residue that dissipates daily (unitless);

t = post-application day on which exposure is being assessed;

CF2 = weight unit conversion factor (4.54 x 10<sup>8</sup> µg/lb); and

CF3 = area unit conversion factor (1.08 x 10<sup>-3</sup> ft<sup>2</sup>/cm<sup>2</sup> or 2.47 x 10<sup>-8</sup> acre/cm<sup>2</sup>).

Absorbed dose, normalized to body weight, is calculated as:

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

where:

D = dose (mg/kg-day);

E = exposure (mg/day);

AF = absorption factor (dermal); and

BW = body weight (kg).

Table A-1: Turf (Golfing) – Inputs for Residential Post-application Dermal Exposure		
Algorithm Notation	Exposure Factor (units)	Point Estimate(s)
AR	Application rate (mass active ingredient per unit area)	See Appendix D
F	Fraction of AR as TTR following application	L/WP/WDG 0.01
F <sub>D</sub>	Daily residue dissipation	Granules 0.002
TC	Transfer Coefficient (cm <sup>2</sup> /hr)	L/WP/WDG 0.1
		Granules 0.1
		Adult 5,300
ET	Exposure time (hours per day)	Children 11 < 16 years old 4,400
		Children 6 < 11 years old 2,900
		Pesticides used on greens, tees, and fairways 4
BW	Body Weight (kg)	Pesticides used only on greens and tees 1
		Adults 80
		Children 11 < 16 years old 57
		Children 6 < 11 years old 32
NA = not applicable L/WP/WDG = liquid/wettable powder/water dispersible granule		

### Occupational Non-cancer Handler Algorithms

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

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

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:

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

where:

DFR<sub>t</sub> = dislodgeable foliage residue on day "t" (µg/cm<sup>2</sup>),  
 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<sup>2</sup>/hr),  
 DFR<sub>t</sub> = dislodgeable foliar residue on day "t" (µg/cm<sup>2</sup>), 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).

#### Occupational Non-cancer Algorithms for Loaders/Planters of Commercially Treated Seed and for On-farm Seed Treatment/Planting

Potential daily exposures for occupational loaders/planters of commercially treated seed and for on-farm seed treatment/planting are calculated using the following formulas:

$$E = UE * AR * 2.2 \times 10^{-6} \text{ lb/mg} * ASP * 0.001 \text{ mg/ug}$$

where:

E = exposure (mg ai/day),  
 UE = unit exposure (µg ai/lb ai),  
 AR = maximum application rate according to proposed label (mg ai/seed), and  
 ASP = amount of seed planted or, for on-farm, amount of seed treated and then planted (# seeds/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).

## Appendix B. Summary of Occupational and Residential Cancer Algorithms

### Residential Post-application

For residential post-application cancer assessments, a yearly average deposited residue is calculated using the daily dissipation rate and retreatment interval.

*Yearly Average Deposited Residue (mg/kg/day) = ( $\sum$  Day 0 deposited residue to Day 365 deposited residue)  $\div$  365*

The deposited residue on each day after application is calculated using the following equation:

*Day X deposited residue = previous days deposited residue  $\times e^{\wedge} [-(\text{daily dissipation rate}) \times \text{number of days since most recent application}]$*

Using the yearly average deposited residue, a yearly average absorbed dose is calculated using the 2012 Residential SOP algorithms for the appropriate scenario. The next step required to calculate carcinogenic risk estimates is to amortize these values over the anticipated lifetime, which results in the LADD. LADD values are calculated using the following equation:

*LADD = Yearly Average Absorbed Dose (mg/kg/day)  $\times$  [days of post-app exposure  $\div$  days in a year (365)]  $\times$  [years of exposure (50 years)  $\div$  average lifespan (78 years)]*

Cancer risk estimate calculations are then completed by multiplying the LADD values calculated above by the  $Q_1^*$  for the chemical. Cancer risk estimates are calculated using the following equation:

$$\text{Total Cancer Risk Estimate} = (\text{Dermal LADD} + \text{Inhalation LADD}) * Q_1^*$$

where:

Cancer Risk Estimate = probability of incidence of cancer cases over a lifetime (unitless),  
 Dermal LADD = absorbed dose from dermal exposure over a lifetime (mg ai/kg/day),  
 Inhalation LADD = absorbed dose from inhalation exposure over a lifetime (mg ai/kg/day),  
 and  
 $Q_1^*$  = quantitative dose response factor used for linear, low-dose response cancer risk estimate calculations (mg/kg/day)<sup>-1</sup>.

### Occupational Handler

After the development of the ADD values, the next step required to calculate carcinogenic risk estimates is to amortize these values over the anticipated lifetime, which results in the LADD. LADD values are calculated using the following equation:

$$\text{LADD} = \text{ADD} * \frac{\text{Days per Year of Exposure}}{365 \text{ Days per Year}} * \frac{\text{Years per Lifetime of Exposure}}{\text{Lifetime Expectancy}}$$

where:

LADD	=	absorbed dose over a lifetime (mg ai/kg/day),
ADD	=	average daily dose absorbed in a given scenario (mg ai/kg/day),
Days per Year of Exposure	=	annual frequency of an application by an individual (days/year),
Years per Lifetime of Exposure	=	amount of a lifetime that an individual would be expected to use pesticides (years), and
Lifetime Expectancy	=	average life expectancy of an individual (years).

Cancer risk estimate calculations are completed by multiplying the LADD values calculated above by the  $Q_1^*$  for the chemical. Cancer risk estimates are calculated using the following equation:

$$\text{Total Cancer Risk Estimate} = (\text{Dermal LADD} + \text{Inhalation LADD}) * Q_1^*$$

where:

Cancer Risk Estimate	=	probability of incidence of cancer cases over a lifetime (unitless),
Dermal LADD	=	absorbed dose from dermal exposure over a lifetime (mg ai/kg/day),
Inhalation LADD	=	absorbed dose from inhalation exposure over a lifetime (mg ai/kg/day), and
$Q_1^*$	=	quantitative dose response factor used for linear, low-dose response cancer risk estimate calculations (mg/kg/day) <sup>-1</sup> .

#### Occupational Post-Application

For occupational post-application cancer assessments, the absorbed dose on the day of application and each day up to 30 days after application is calculated accounting for daily dissipation. A 30-day average dose is then calculated and used to determine the LADD.

$$\text{LADD} = \text{Average Absorbed Dose (mg/kg/day)} \times [\text{days of post-app exposure} \div \text{days in a year (365)}] \times [\text{years of exposure (35 years)} \div \text{average lifespan (78 years)}]$$

Cancer risk estimate calculations are then completed by multiplying the LADD values calculated above by the  $Q_1^*$  for the chemical. Cancer risk estimates are calculated using the following equation:

$$\text{Total Cancer Risk Estimate} = (\text{Dermal LADD} + \text{Inhalation LADD}) * Q_1^*$$

where:

Cancer Risk Estimate	=	probability of incidence of cancer cases over a lifetime (unitless),
Dermal LADD	=	absorbed dose from dermal exposure over a lifetime (mg ai/kg/day),
Inhalation LADD	=	absorbed dose from inhalation exposure over a lifetime (mg ai/kg/day), and
$Q_1^*$	=	quantitative dose response factor used for linear, low-dose response cancer risk estimate calculations (mg/kg/day) <sup>-1</sup> .

## Appendix C. 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.

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

where:

TTR	=	turf transferable residue ( $\mu\text{g}/\text{cm}^2$ )
DF	=	drift fraction of spray drift that deposits on lawns (unitless)
AR	=	application rate (lbs ai/ft <sup>2</sup> 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 ( $4.54 \times 10^8 \mu\text{g}/\text{lb}$ )
CF3	=	area unit conversion factor ( $1.08 \times 10^{-3} \text{ft}^2/\text{cm}^2$ or $2.47 \times 10^{-8} \text{acre}/\text{cm}^2$ )

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, groundboom, and airblast application scenarios, based on average deposition values at each distance of interest, are shown in the tables below (Tables B-1, -2, -3).

Droplet Size <sup>+</sup>	Distance Downwind From Treated Field (feet)										
	0	10	25	50	75	100	125	150	200	250	300
<i>Fine to Medium*</i>	<b>0.257</b>	<b>0.209</b>	<b>0.169</b>	<b>0.129</b>	<b>0.098</b>	<b>0.076</b>	<b>0.063</b>	<b>0.054</b>	<b>0.041</b>	<b>0.034</b>	<b>0.028</b>
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
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

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

Droplet Size <sup>+</sup>	Distance Downwind From Treated Field (feet)										
	0	10	25	50	75	100	125	150	200	250	300
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):  $D_{v0.5} = 255 \mu\text{M}$ ; Medium (M):  $D_{v0.5} = 294 \mu\text{M}$ ; Medium to Coarse (M2C):  $D_{v0.5} = 341 \mu\text{M}$ ; Coarse (C)  $D_{v0.5} = 385 \mu\text{M}$ ; Coarse to Very Coarse (C2VC):  $D_{v0.5} = 439 \mu\text{M}$ ; Very Coarse (VC):  $D_{v0.5} = 478 \mu\text{M}$  & Very Fine to Fine (VF2F):  $D_{v0.5} = 137 \mu\text{M}$  – only to be used with labeling justification

**Table C-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	<i>Very Fine to Fine</i>	<b>0.187</b>	<b>0.093</b>	<b>0.056</b>	<b>0.035</b>	<b>0.025</b>	<b>0.020</b>	<b>0.017</b>	<b>0.014</b>	<b>0.011</b>	<b>0.008</b>	<b>0.007</b>
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/Coars	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  $\mu\text{M}$

**Table C-3. Average Drift Fractions for a 50' Wide Lawn Starting at Various Distances Downwind From a Field Treated Using Orchard Blast Equipment.**

Crop Canopy	Distance Downwind From Treated Field (feet)										
	0	10	25	50	75	100	125	150	200	250	300
<i>Sparse</i>	<b>0.1435</b>	<b>0.0834</b>	<b>0.0443</b>	<b>0.0200</b>	<b>0.0110</b>	<b>0.0068</b>	<b>0.0045</b>	<b>0.0032</b>	<b>0.0018</b>	<b>0.0011</b>	<b>0.0008</b>
Normal	0.0030	0.0020	0.0013	0.0009	0.0006	0.0005	0.0004	0.0003	0.0003	0.0002	0.0002
Dense	0.0422	0.0279	0.0175	0.0100	0.0067	0.0049	0.0039	0.0032	0.0023	0.0018	0.0015
Vineyard	0.0080	0.0041	0.0022	0.0012	0.0008	0.0006	0.0005	0.0004	0.0003	0.0002	0.0002

Sparse (Young, Dormant): This composite orchard combines small grapefruit and dormant apple orchards.  
 Normal (Stone and Pome Fruit, Vineyard): This composite orchard combines grape and orchards.  
 Dense (Citrus, Tall Trees): This composite orchard combines almond, orange, grapefruit, small grapefruit (mist blower) and pecan orchards.  
 Vineyard: This composite curve combines grape air blast sprayer applications and may not apply to other application equipment.  
 Note: AgDrift also contains an "Orchard" scenario which is a composite of results from all tree canopy types. Since it is a composite it has not been included.

### 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 <sub>t</sub>	=	turf transferable residue on day t (µg/cm <sup>2</sup> );
CF1	=	weight unit conversion factor (0.001 mg/µg);
TC	=	transfer coefficient (cm <sup>2</sup> /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).

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 <sub>d</sub>	Daily residue dissipation (if chemical-specific data are unavailable) (fraction)	L/WP/WDG	0.1	
		Granules	0.1	
TC	Transfer Coefficient (cm <sup>2</sup> /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	

### Post-application Hand-to-Mouth Exposure Algorithm—Physical Activities on Turf

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

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

where:

E	=	exposure (mg/day);
HR	=	hand residue loading (mg/cm <sup>2</sup> );
F <sub>M</sub>	=	fraction hand surface area mouthed / event (fraction/event);
SA <sub>H</sub>	=	typical surface area of one hand (cm <sup>2</sup> );
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

$$HR = \frac{F_{ai\_hands} * DE}{SA_H * 2}$$

where:

HR	=	hand residue loading (mg/cm <sup>2</sup> );
F <sub>ai<sub>hands</sub></sub>	=	fraction ai on hands compared to total surface residue from dermal transfer coefficient study (unitless);
DE	=	dermal exposure (mg); and
SA <sub>H</sub>	=	typical surface area of one hand (cm <sup>2</sup> ).

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).

<b>Algorithm Notation</b>	<b>Exposure Factor (units)</b>		<b>Point Estimate(s)</b>
Fai <sub>hands</sub>	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 <sub>H</sub>	Typical surface area of one hand (cm <sup>2</sup> ), 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 <sup>2</sup> )		Calculated via (DE * Fai <sub>hands</sub> )/SA <sub>H</sub>
F <sub>M</sub>	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

Table C-6. Children (1 to < 2 years old) Risk Estimates (MOEs) Related to Indirect Exposure to Spray Drift for ETU for the Incidental Oral Route of Exposure - Mancozeb.														
Crop/Rate Group	Spray Type/ Nozzle Configuration	Applica. Rate (lb ai/A)	Adjusted TTR <sub>t</sub> (ug/cm <sup>2</sup> )	At Edge	10 Feet	25 Feet	50 Feet	75 Feet	100 Feet	125 Feet	150 Feet	200 Feet	250 Feet	300 Feet
				Combined MOE										
<b>Almond (orchard/vineyard highest rate) and Cranberry (typical acreage field crop highest rate)</b>														
Aerial	<i>Fine to Medium</i>	4.8	0.53352	530	650	810	1,100	1,400	1,800	2,200	2,500	3,300	4,000	4,900
	Medium to Coarse			650	880	1,200	1,700	2,400	3,100	3,900	4,700	6,500	8,600	11,000
	Coarse to Very Coarse			750	1,100	1,700	2,600	3,700	4,900	6,200	7,600	11,000	14,000	17,000
	Very Fine to Fine			370	400	450	520	610	690	780	880	1,100	1,300	1,400
	AT401, M, 10 mph, 37% SD			580	750	960	1,300	1,800	2,300	2,800	3,300	4,300	5,300	6,500
	WASP, M, 10 mph, 37% SD			630	800	1,100	1,600	2,200	2,800	3,400	4,000	5,300	6,500	7,600
	AT401, C, 10 mph, 25% SD			690	970	1,400	2,000	2,900	3,800	4,700	5,700	8,000	11,000	12,000
	WASP, C, 10 mph, 25% SD			800	1,100	1,600	2,600	3,600	4,900	5,900	7,600	11,000	14,000	15,000
	AT401, VC, 10 mph, 20% SD			780	1,200	1,900	3,100	4,400	5,900	7,600	9,800	14,000	17,000	23,000
	WASP, VC, 10 mph, 20% SD			990	1,600	2,400	3,800	5,500	7,200	9,800	11,000	17,000	20,000	23,000
Groundboom	<i>High Boom Very fine to Fine</i>	4.8	0.53352	730	1,500	2,400	3,900	5,500	6,800	8,000	9,800	12,000	17,000	20,000
	Low Boom Very fine to Fine			1,600	4,300	6,800	11,000	14,000	17,000	20,000	23,000	27,000	34,000	46,000
	High Boom Fine to Medium/Coarse			2,800	7,200	11,000	15,000	20,000	23,000	27,000	27,000	34,000	46,000	46,000
	Low Boom Fine to Medium/Coarse			4,100	11,000	17,000	23,000	27,000	34,000	46,000	46,000	68,000	68,000	68,000
Airblast	<i>Sparse</i>	4.8	0.53352	950	1,600	3,100	6,800	12,000	20,000	30,000	43,000	76,000	120,000	170,000
	Normal			46,000	68,000	110,000	150,000	230,000	270,000	340,000	460,000	460,000	680,000	680,000
	Dense			3,200	4,900	7,800	14,000	20,000	28,000	35,000	43,000	59,000	76,000	91,000
	Vineyard			17,000	33,000	62,000	110,000	170,000	230,000	270,000	340,000	460,000	680,000	680,000

Table C-6. Children (1 to < 2 years old) Risk Estimates (MOEs) Related to Indirect Exposure to Spray Drift for ETU for the Incidental Oral Route of Exposure - Mancozeb.														
Crop/Rate Group	Spray Type/ Nozzle Configuration	Applica. Rate (lb ai/A)	Adjusted TTR <sub>t</sub> (ug/cm <sup>2</sup> )	At Edge	10 Feet	25 Feet	50 Feet	75 Feet	100 Feet	125 Feet	150 Feet	200 Feet	250 Feet	300 Feet
				Combined MOE										
<b>Barley (high acreage field crop highest rate)</b>														
Aerial	<i>Fine to Medium</i>	1.6	0.17784	1,600	2,000	2,400	3,200	4,200	5,400	6,500	7,600	10,000	12,000	15,000
	Medium to Coarse			1,900	2,600	3,600	5,000	7,100	9,300	12,000	14,000	20,000	26,000	32,000
	Coarse to Very Coarse			2,200	3,300	5,000	7,700	11,000	15,000	19,000	23,000	32,000	41,000	51,000
	Very Fine to Fine			1,100	1,200	1,300	1,600	1,800	2,100	2,300	2,600	3,200	3,800	4,300
	AT401, M, 10 mph, 37% SD			1,800	2,200	2,900	3,900	5,300	6,800	8,400	9,800	13,000	16,000	20,000
	WASP, M, 10 mph, 37% SD			1,900	2,400	3,200	4,800	6,500	8,400	10,000	12,000	16,000	20,000	23,000
	AT401, C, 10 mph, 25% SD			2,100	2,900	4,100	6,100	8,700	11,000	14,000	17,000	24,000	32,000	37,000
	WASP, C, 10 mph, 25% SD			2,400	3,400	4,900	7,700	11,000	15,000	18,000	23,000	32,000	41,000	46,000
	AT401, VC, 10 mph, 20% SD			2,300	3,600	5,700	9,300	13,000	18,000	23,000	29,000	41,000	51,000	68,000
	WASP, VC, 10 mph, 20% SD			3,000	4,700	7,200	11,000	16,000	22,000	29,000	34,000	51,000	59,000	68,000
Groundboom	<i>High Boom Very fine to Fine</i>	1.6	0.17784	2,200	4,400	7,300	12,000	16,000	21,000	24,000	29,000	37,000	51,000	59,000
	Low Boom Very fine to Fine			4,800	13,000	21,000	32,000	41,000	51,000	59,000	68,000	82,000	100,000	140,000
	High Boom Fine to Medium/Coarse			8,400	22,000	32,000	46,000	59,000	68,000	82,000	82,000	100,000	140,000	140,000
	Low Boom Fine to Medium/Coarse			12,000	34,000	51,000	68,000	82,000	100,000	140,000	140,000	210,000	210,000	210,000
Airblast	<i>Sparse</i>	1.6	0.17784	2,900	4,900	9,300	21,000	37,000	60,000	91,000	130,000	230,000	370,000	510,000
	Normal			140,000	210,000	320,000	460,000	680,000	820,000	1,000,000	1,400,000	1,400,000	2,100,000	2,100,000
	Dense			9,700	15,000	23,000	41,000	61,000	84,000	110,000	130,000	180,000	230,000	270,000
	Vineyard			51,000	100,000	190,000	340,000	510,000	680,000	820,000	1,000,000	1,400,000	2,100,000	2,100,000

Table C-6. Children (1 to < 2 years old) Risk Estimates (MOEs) Related to Indirect Exposure to Spray Drift for ETU for the Incidental Oral Route of Exposure - Mancozeb.														
Crop/Rate Group	Spray Type/ Nozzle Configuration	Applica. Rate (lb ai/A)	Adjusted TTR <sub>t</sub> (ug/cm <sup>2</sup> )	At Edge	10 Feet	25 Feet	50 Feet	75 Feet	100 Feet	125 Feet	150 Feet	200 Feet	250 Feet	300 Feet
				Combined MOE										
<b>Pear, SLN Rate</b>														
Aerial	<i>Fine to Medium</i>	6.38	0.709137	400	490	610	800	1,100	1,400	1,600	1,900	2,500	3,000	3,700
	Medium to Coarse			490	660	900	1,300	1,800	2,300	2,900	3,500	4,900	6,400	7,900
	Coarse to Very Coarse			560	830	1,300	1,900	2,800	3,700	4,700	5,700	7,900	10,000	13,000
	Very Fine to Fine			280	300	340	390	460	520	590	660	810	950	1,100
	AT401, M, 10 mph, 37% SD			440	560	720	980	1,300	1,700	2,100	2,500	3,200	4,000	4,900
	WASP, M, 10 mph, 37% SD			470	600	800	1,200	1,600	2,100	2,600	3,000	4,000	4,900	5,700
	AT401, C, 10 mph, 25% SD			520	730	1,000	1,500	2,200	2,900	3,500	4,300	6,100	7,900	9,400
	WASP, C, 10 mph, 25% SD			600	850	1,200	1,900	2,700	3,700	4,500	5,700	7,900	10,000	11,000
	AT401, VC, 10 mph, 20% SD			590	900	1,400	2,300	3,300	4,500	5,700	7,400	10,000	13,000	17,000
	WASP, VC, 10 mph, 20% SD			750	1,200	1,800	2,900	4,100	5,400	7,400	8,600	13,000	15,000	17,000
Groundboom	<i>High Boom Very fine to Fine</i>	6.38	0.709137	550	1,100	1,800	2,900	4,100	5,100	6,100	7,400	9,400	13,000	15,000
	Low Boom Very fine to Fine			1,200	3,200	5,100	7,900	10,000	13,000	15,000	17,000	21,000	26,000	34,000
	High Boom Fine to Medium/Coarse			2,100	5,400	7,900	11,000	15,000	17,000	21,000	21,000	26,000	34,000	34,000
	Low Boom Fine to Medium/Coarse			3,100	8,600	13,000	17,000	21,000	26,000	34,000	34,000	51,000	51,000	51,000
Airblast	<i>Sparse</i>	6.38	0.709137	720	1,200	2,300	5,100	9,400	15,000	23,000	32,000	57,000	94,000	130,000
	Normal			34,000	51,000	79,000	110,000	170,000	210,000	260,000	340,000	340,000	510,000	510,000
	Dense			2,400	3,700	5,900	10,000	15,000	21,000	26,000	32,000	45,000	57,000	69,000
	Vineyard			13,000	25,000	47,000	86,000	130,000	170,000	210,000	260,000	340,000	510,000	510,000

Table C-7. Adult Risk Estimates (MOEs) Related to Indirect Exposure to Spray Drift for ETU for the Dermal Route of Exposure - ETU.														
Crop/Rate Group	Spray Type/ Nozzle Configuration	Applica. Rate (lb ai/A)	Adjusted TTR (ug/cm2)	At Edge	10 Feet	25 Feet	50 Feet	75 Feet	100 Feet	125 Feet	150 Feet	200 Feet	250 Feet	300 Feet
				Dermal MOE										
<b>Almond (orchard/vineyard highest rate) and Cranberry (typical acreage field crop highest rate)</b>														
Aerial	<i>Fine to Medium</i>	4.8	0.00828319	420	520	640	840	1,100	1,400	1,700	2,000	2,700	3,200	3,900
	Medium to Coarse			520	700	950	1,300	1,900	2,500	3,100	3,800	5,200	6,800	8,400
	Coarse to Very Coarse			590	880	1,300	2,100	2,900	3,900	4,900	6,000	8,400	11,000	14,000
	Very Fine to Fine			290	320	360	420	480	550	620	700	860	1,000	1,100
	AT401, M, 10 mph, 37% SD			460	590	770	1,000	1,400	1,800	2,200	2,600	3,400	4,200	5,200
	WASP, M, 10 mph, 37% SD			500	640	840	1,300	1,700	2,200	2,700	3,200	4,200	5,200	6,000
	AT401, C, 10 mph, 25% SD			550	770	1,100	1,600	2,300	3,000	3,800	4,500	6,400	8,400	9,900
	WASP, C, 10 mph, 25% SD			640	900	1,300	2,100	2,900	3,900	4,700	6,000	8,400	11,000	12,000
	AT401, VC, 10 mph, 20% SD			620	950	1,500	2,500	3,500	4,700	6,000	7,800	11,000	14,000	18,000
	WASP, VC, 10 mph, 20% SD			790	1,200	1,900	3,000	4,400	5,700	7,800	9,100	14,000	16,000	18,000
Groundboom	<i>High Boom Very fine to Fine</i>	4.8	0.00828319	580	1,200	1,900	3,100	4,400	5,400	6,400	7,800	9,900	14,000	16,000
	Low Boom Very fine to Fine			1,300	3,400	5,400	8,400	11,000	14,000	16,000	18,000	22,000	27,000	36,000
	High Boom Fine to Medium/Coarse			2,200	5,700	8,400	12,000	16,000	18,000	22,000	22,000	27,000	36,000	36,000
	Low Boom Fine to Medium/Coarse			3,300	9,100	14,000	18,000	22,000	27,000	36,000	36,000	54,000	54,000	54,000
Airblast	<i>Sparse</i>	4.8	0.00828319	760	1,300	2,500	5,400	9,900	16,000	24,000	34,000	60,000	99,000	140,000
	Normal			36,000	54,000	84,000	120,000	180,000	220,000	270,000	360,000	360,000	540,000	540,000
	Dense			2,600	3,900	6,200	11,000	16,000	22,000	28,000	34,000	47,000	60,000	73,000
	Vineyard			14,000	27,000	49,000	91,000	140,000	180,000	220,000	270,000	360,000	540,000	540,000

Table C-7. Adult Risk Estimates (MOEs) Related to Indirect Exposure to Spray Drift for ETU for the Dermal Route of Exposure - ETU.														
Crop/Rate Group	Spray Type/ Nozzle Configuration	Applica. Rate (lb ai/A)	Adjusted TTR (ug/cm2)	At Edge	10 Feet	25 Feet	50 Feet	75 Feet	100 Feet	125 Feet	150 Feet	200 Feet	250 Feet	300 Feet
				Dermal MOE										
<b>Barley (high acreage field crop highest rate)</b>														
Aerial	<i>Fine to Medium</i>	1.6	0.00276106	1,300	1,600	1,900	2,500	3,300	4,300	5,200	6,000	8,000	9,600	12,000
	Medium to Coarse			1,500	2,100	2,800	4,000	5,600	7,400	9,300	11,000	16,000	20,000	25,000
	Coarse to Very Coarse			1,800	2,600	4,000	6,200	8,800	12,000	15,000	18,000	25,000	33,000	41,000
	Very Fine to Fine			870	960	1,100	1,200	1,400	1,700	1,900	2,100	2,600	3,000	3,400
	AT401, M, 10 mph, 37% SD			1,400	1,800	2,300	3,100	4,200	5,400	6,700	7,800	10,000	13,000	16,000
	WASP, M, 10 mph, 37% SD			1,500	1,900	2,500	3,800	5,200	6,700	8,200	9,600	13,000	16,000	18,000
	AT401, C, 10 mph, 25% SD			1,600	2,300	3,300	4,900	6,900	9,100	11,000	14,000	19,000	25,000	30,000
	WASP, C, 10 mph, 25% SD			1,900	2,700	3,900	6,200	8,600	12,000	14,000	18,000	25,000	33,000	36,000
	AT401, VC, 10 mph, 20% SD			1,900	2,800	4,500	7,400	11,000	14,000	18,000	23,000	33,000	41,000	54,000
	WASP, VC, 10 mph, 20% SD			2,400	3,700	5,700	9,100	13,000	17,000	23,000	27,000	41,000	47,000	54,000
Groundboom	<i>High Boom Very fine to Fine</i>			1,700	3,500	5,800	9,300	13,000	16,000	19,000	23,000	30,000	41,000	47,000
	Low Boom Very fine to Fine			3,800	10,000	16,000	25,000	33,000	41,000	47,000	54,000	65,000	82,000	110,000
	High Boom Fine to Medium/Coarse			6,700	17,000	25,000	36,000	47,000	54,000	65,000	65,000	82,000	110,000	110,000
	Low Boom Fine to Medium/Coarse			9,900	27,000	41,000	54,000	65,000	82,000	110,000	110,000	160,000	160,000	160,000
Airblast	<i>Sparse</i>			2,300	3,900	7,400	16,000	30,000	48,000	73,000	100,000	180,000	300,000	410,000
	Normal			110,000	160,000	250,000	360,000	540,000	650,000	820,000	1,100,000	1,100,000	1,600,000	1,600,000
	Dense			7,700	12,000	19,000	33,000	49,000	67,000	84,000	100,000	140,000	180,000	220,000
	Vineyard			41,000	80,000	150,000	270,000	410,000	540,000	650,000	820,000	1,100,000	1,600,000	1,600,000

Table C-7. Adult Risk Estimates (MOEs) Related to Indirect Exposure to Spray Drift for ETU for the Dermal Route of Exposure - ETU.														
Crop/Rate Group	Spray Type/ Nozzle Configuration	Applica. Rate (lb ai/A)	Adjusted TTR (ug/cm2)	At Edge	10 Feet	25 Feet	50 Feet	75 Feet	100 Feet	125 Feet	150 Feet	200 Feet	250 Feet	300 Feet
				Dermal MOE										
<b>Pear, SLN Rate</b>														
Groundboom	<i>High Boom Very fine to Fine</i>			440	880	1,500	2,300	3,300	4,100	4,800	5,800	7,400	10,000	12,000
	Low Boom Very fine to Fine			960	2,600	4,100	6,300	8,200	10,000	12,000	14,000	16,000	20,000	27,000
	High Boom Fine to Medium/Coarse			1,700	4,300	6,300	9,100	12,000	14,000	16,000	16,000	20,000	27,000	27,000
	Low Boom Fine to Medium/Coarse			2,500	6,800	10,000	14,000	16,000	20,000	27,000	27,000	41,000	41,000	41,000
Airblast	<i>Sparse</i>			570	980	1,800	4,100	7,400	12,000	18,000	26,000	45,000	74,000	100,000
	Normal			27,000	41,000	63,000	91,000	140,000	160,000	200,000	270,000	270,000	410,000	410,000
	Dense			1,900	2,900	4,700	8,200	12,000	17,000	21,000	26,000	36,000	45,000	55,000
	Vineyard			10,000	20,000	37,000	68,000	100,000	140,000	160,000	200,000	270,000	410,000	410,000

Table C-8. Children (1 to < 2 years old) Risk Estimates (MOEs) Related to Indirect Exposure to Spray Drift for ETU for the Combined Dermal and Incidental Oral Routes of Exposure - ETU.														
Crop/Rate Group	Spray Type/ Nozzle Configuration	Applica. Rate (lb ai/A)	Adjusted TTR <sub>i</sub> (ug/cm <sup>2</sup> )	At Edge	10 Feet	25 Feet	50 Feet	75 Feet	100 Feet	125 Feet	150 Feet	200 Feet	250 Feet	300 Feet
				Combined MOE										
<b>Almond (orchard/vineyard highest rate) and Cranberry (typical acreage field crop highest rate)</b>														
Aerial	<i>Fine to Medium</i>	4.8	0.008283 19	140	180	220	290	430	480	580	680	900	1,100	1,300
	Medium to Coarse			170	270	320	450	720	840	1,100	1,300	1,800	2,300	2,800
	Coarse to Very Coarse			200	340	450	690	1,100	1,300	1,700	2,000	2,800	3,700	4,600
	Very Fine to Fine			99	120	120	140	190	190	210	240	290	340	390
	AT401, M, 10 mph, 37% SD			160	230	260	350	540	610	750	880	1,200	1,400	1,800
	WASP, M, 10 mph, 37% SD			170	240	290	430	660	750	920	1,100	1,400	1,800	2,000
	AT401, C, 10 mph, 25% SD			190	300	370	550	890	1,000	1,300	1,500	2,200	2,800	3,300
	WASP, C, 10 mph, 25% SD			220	350	440	690	1,100	1,300	1,600	2,000	2,800	3,700	4,100
	AT401, VC, 10 mph, 20% SD			210	360	510	840	1,400	1,600	2,000	2,600	3,700	4,600	6,100
	WASP, VC, 10 mph, 20% SD			270	480	650	1,000	1,700	1,900	2,600	3,100	4,600	5,300	6,100
Groundboom	<i>High Boom Very fine to Fine</i>	4.8	0.008283 19	200	450	660	1,100	1,700	1,800	2,200	2,600	3,300	4,600	5,300
	Low Boom Very fine to Fine			430	1,300	1,800	2,800	4,200	4,600	5,300	6,100	7,400	9,200	12,000
	High Boom Fine to Medium/Coarse			750	2,200	2,800	4,100	6,000	6,100	7,400	7,400	9,200	12,000	12,000
	Low Boom Fine to Medium/Coarse			1,100	3,500	4,600	6,100	8,400	9,200	12,000	12,000	18,000	18,000	18,000
Airblast	<i>Sparse</i>	4.8	0.008283 19	260	500	830	1,800	3,800	5,400	8,200	12,000	20,000	33,000	46,000
	Normal			12,000	21,000	28,000	41,000	70,000	74,000	92,000	120,000	120,000	180,000	180,000
	Dense			870	1,500	2,100	3,700	6,300	7,500	9,400	12,000	16,000	20,000	25,000
	Vineyard			4,600	10,000	17,000	31,000	52,000	61,000	74,000	92,000	120,000	180,000	180,000

Table C-8. Children (1 to < 2 years old) Risk Estimates (MOEs) Related to Indirect Exposure to Spray Drift for ETU for the Combined Dermal and Incidental Oral Routes of Exposure - ETU.														
Crop/Rate Group	Spray Type/ Nozzle Configuration	Applica. Rate (lb ai/A)	Adjusted TTR <sub>t</sub> (ug/cm <sup>2</sup> )	At Edge	10 Feet	25 Feet	50 Feet	75 Feet	100 Feet	125 Feet	150 Feet	200 Feet	250 Feet	300 Feet
				Combined MOE										
<b>Barley (high acreage field crop highest rate)</b>														
Aerial	<i>Fine to Medium</i>	1.6	0.00276106	430	600	650	860	1,300	1,500	1,800	2,000	2,700	3,300	3,900
	Medium to Coarse			520	810	960	1,300	2,200	2,500	3,200	3,800	5,300	6,900	8,500
	Coarse to Very Coarse			600	1,000	1,300	2,100	3,400	3,900	5,000	6,100	8,500	11,000	14,000
	Very Fine to Fine			300	370	360	420	560	560	630	710	870	1,000	1,200
	AT401, M, 10 mph, 37% SD			470	690	780	1,100	1,600	1,800	2,300	2,600	3,500	4,300	5,300
	WASP, M, 10 mph, 37% SD			510	730	860	1,300	2,000	2,300	2,800	3,300	4,300	5,300	6,100
	AT401, C, 10 mph, 25% SD			560	890	1,100	1,600	2,700	3,100	3,800	4,600	6,500	8,500	10,000
	WASP, C, 10 mph, 25% SD			650	1,000	1,300	2,100	3,300	3,900	4,800	6,100	8,500	11,000	12,000
	AT401, VC, 10 mph, 20% SD			630	1,100	1,500	2,500	4,100	4,800	6,100	7,900	11,000	14,000	18,000
	WASP, VC, 10 mph, 20% SD			800	1,400	1,900	3,100	5,000	5,800	7,900	9,200	14,000	16,000	18,000
Groundboom	<i>High Boom Very fine to Fine</i>	1.6	0.00276106	590	1,400	2,000	3,200	5,000	5,500	6,500	7,900	10,000	14,000	16,000
	Low Boom Very fine to Fine			1,300	3,900	5,500	8,500	13,000	14,000	16,000	18,000	22,000	28,000	37,000
	High Boom Fine to Medium/Coarse			2,300	6,600	8,500	12,000	18,000	18,000	22,000	22,000	28,000	37,000	37,000
	Low Boom Fine to Medium/Coarse			3,300	10,000	14,000	18,000	25,000	28,000	37,000	37,000	55,000	55,000	55,000
Airblast	<i>Sparse</i>	1.6	0.00276106	770	1,500	2,500	5,500	11,000	16,000	25,000	35,000	61,000	100,000	140,000
	Normal			37,000	63,000	85,000	120,000	210,000	220,000	280,000	370,000	370,000	550,000	550,000
	Dense			2,600	4,500	6,300	11,000	19,000	23,000	28,000	35,000	48,000	61,000	74,000
	Vineyard			14,000	31,000	50,000	92,000	160,000	180,000	220,000	280,000	370,000	550,000	550,000

Table C-8. Children (1 to < 2 years old) Risk Estimates (MOEs) Related to Indirect Exposure to Spray Drift for ETU for the Combined Dermal and Incidental Oral Routes of Exposure - ETU.														
Crop/Rate Group	Spray Type/ Nozzle Configuration	Applica. Rate (lb ai/A)	Adjusted TTR <sub>i</sub> (ug/cm <sup>2</sup> )	At Edge	10 Feet	25 Feet	50 Feet	75 Feet	100 Feet	125 Feet	150 Feet	200 Feet	250 Feet	300 Feet
				Combined MOE										
<b>Pear, SLN Rate</b>														
Groundboom	<i>High Boom Very fine to Fine</i>			150	340	490	790	1,300	1,400	1,600	2,000	2,500	3,500	4,000
	Low Boom Very fine to Fine			330	980	1,400	2,100	3,200	3,500	4,000	4,600	5,500	6,900	9,200
	High Boom Fine to Medium/Coarse			570	1,700	2,100	3,100	4,500	4,600	5,500	5,500	6,900	9,200	9,200
	Low Boom Fine to Medium/Coarse			840	2,600	3,500	4,600	6,300	6,900	9,200	9,200	14,000	14,000	14,000
Airblast	<i>Sparse</i>			190	380	630	1,400	2,900	4,100	6,200	8,700	15,000	25,000	35,000
	Normal			9,200	16,000	21,000	31,000	53,000	55,000	69,000	92,000	92,000	140,000	140,000
	Dense			660	1,100	1,600	2,800	4,700	5,700	7,100	8,700	12,000	15,000	18,000
	Vineyard			3,500	7,700	13,000	23,000	39,000	46,000	55,000	69,000	92,000	140,000	140,000

## Appendix D. Summary of Use Directions

Table D-1. Summary of Use Directions for Registered Uses of Mancozeb - Foliar										
Crop/ Use Site	Formulation <sup>1</sup>	% AI	Registration Number	Application Type and Equipment	Application Rate (lb. ai/A)	Gallons of Water/Acre	Retreatment Interval (RTI; days)	Restricted Entry Interval (REI)	Pre-Harvest Interval (PHI; days)	Personal Protective Equipment (PPE) <sup>2</sup>
<b>Orchard/Vineyard<sup>3</sup></b>										
Almond	DF	75	70506-234	Aerial, Ground, Handheld, Chemigation	4.8	2	7	24	NS	SL, G
	SC	75	34704-1120	Aerial, Ground, Handheld, Chemigation	4.8	10	7	24	NS	SL, G, Protective Eyewear
Banana	DF	75	70506-234	Aerial, Ground, Handheld, Chemigation	2.25	2	14	24	0	SL, G
	FC	37	70506-194; 62719-396	Aerial, Ground, Handheld, Chemigation	2.4	2	14	24	0	SL, G
	WP	80	70506-183	Aerial, Ground, Handheld, Chemigation	2.4	2	14	24	0	SL, G
Caprifig	DF	75	70506-234	Dip Treatment	0.03 lb ai/gal	100	NS	24	NS	SL, G
	SC	75	34704-1120	Dip Treatment	0.03 lb ai/gal	100	NS	24	NS	SL, G, Protective Eyewear
	WP	80	70506-183	Dip Treatment	0.03 lb ai/gal	25	NS	24	NS	SL, G
Christmas Trees	DF	75	1001-77; 70506-234	Aerial, Ground, Handheld, Chemigation	3	1	7	24	14	SL, G
	FC	37	70506-194; 62719-396	Aerial, Ground, Handheld, Chemigation	3.2	2	14	24	14	SL, G
	WP	80	70506-183	Aerial, Ground, Handheld, Chemigation	3.2	10	14	24	14	SL, G
Grapes, Table/Raisin/Wine/Juice	DF	75	70506-194	Aerial, Ground, Handheld, Chemigation	3	2	3", 8", 7-10d	24	66	SL, G
	FC	37	70506-194; 62719-396	Aerial, Ground, Handheld, Chemigation	3.2	2	0.5", 3", 8", 7-10d	24	66	SL, G
	WP	80	70506-183	Aerial, Ground, Handheld, Chemigation	3.2	10	0.5", 3", 8", 7-10d	24	66	SL, G

Table D-1. Summary of Use Directions for Registered Uses of Mancozeb - Foliar										
Crop/ Use Site	Formulation <sup>1</sup>	% AI	Registration Number	Application Type and Equipment	Application Rate (lb. ai/A)	Gallons of Water/Acre	Retreatment Interval (RTI; days)	Restricted Entry Interval (REI)	Pre-Harvest Interval (PHI; days)	Personal Protective Equipment (PPE) <sup>2</sup>
Papaya	DF	75	70506-234	Aerial, Ground, Handheld, Chemigation	1.88	50	14	24	0	SL, G
	FC	37	70506-194; 62719-396	Aerial, Ground, Handheld, Chemigation	2	20	14	24	0 to 14	SL, G
	WP	80	70506-183	Aerial, Ground, Handheld, Chemigation	1.6	2	14	24	0	SL, G
Pome Fruits (Apple, Crabapple, Quince, Pear)	DF	75	70506-234	Aerial, Ground, Handheld, Chemigation	4.5	50	7	24	77 or DNA after bloom	SL, G
	FC	37	70506-194; 62719-396	Aerial, Ground, Handheld, Chemigation	4.8	2	7	24	77 or DNA after bloom	SL, G
	WP	80	70506-183	<b>Aerial, Ground, Chemigation</b>	<b>4.8</b>	<b>50</b>	7	24	77	SL, G, R
	DF	75	OR170001; WA090019; WA120007	<b>Ground (Pear only)</b>	<b>6.38</b>	<b>100</b>	7	24	77	SL, G, Protective Eyewear
Subtropical/Tropical Fruit (Sugar Apple, Cherimoya, Atemoya, Custard Apple, Sweetsop, Mango, Star Apple, Canistel, Mamey sapote, sapodilla, white sapote)	DF	75	70506-234	Aerial, Ground, Handheld, Chemigation	1.88	10	7	24	0	SL, G
	SC	75	34704-1120	Aerial, Ground, Handheld, Chemigation	1.88	10	7 to 14	24	0	SL, G, Protective Eyewear
	WP	80	70506-183	Aerial, Ground, Handheld, Chemigation	2	10	7 to 14	24	0	SL, G
Walnut	DF	75	70506-234	Aerial, Ground, Handheld	1.8	10	7	24	75	SL, G, R-Aerial
	SC	75	34704-1120	Aerial, Ground, Handheld	1.8	10	7	24	75	SL, G, Protective Eyewear, R-Aerial
<b>Typical Acreage Field Crop<sup>3</sup></b>										
Asparagus	DF	75	70506-234	Aerial, Ground, Handheld, Chemigation (fern)	1.5	2	10	24	120	SL, G
				<b>Dip Treatment</b>	<b>0.0075 lb ai/gal</b>	<b>100</b>	NS		NS	
	FC	37	62719-396; 70506-194	Aerial, Ground, Handheld, Chemigation: fern	1.6	2	10	24	120 to 180	SL, G
				<b>Dip Treatment</b>	<b>0.008 lb ai/gal</b>	<b>100</b>	NS		NS	

Table D-1. Summary of Use Directions for Registered Uses of Mancozeb - Foliar										
Crop/ Use Site	Formulation <sup>1</sup>	% AI	Registration Number	Application Type and Equipment	Application Rate (lb. ai/A)	Gallons of Water/Acre	Retreatment Interval (RTI; days)	Restricted Entry Interval (REI)	Pre-Harvest Interval (PHI; days)	Personal Protective Equipment (PPE) <sup>2</sup>
	WP	80	70506-183	Aerial, Ground, Handheld, Chemigation (fern)	1.6	2	10	24	120 to 180	SL, G
				Dip Treatment	0.008 lb ai/gal	100	NS		NS	
Broccoli	DF	75	70506-234	Aerial, Ground, Handheld, Chemigation	1.58	2	7	24	7	SL, G, R-Aerial
	FC	37	70506-194; 62719-396	Aerial, Ground, Handheld, Chemigation	1.6	2	7	24	7	SL, G, R-Aerial
	WP	80	70506-183	Aerial, Ground, Handheld, Chemigation	1.6	2	7	24	7	SL, G
Cabbage	DF	75	70506-234	Aerial, Ground, Handheld, Chemigation	1.58	2	7	24	7	SL, G, R-Aerial
	SC	75	34704-1120	Aerial, Ground, Handheld, Chemigation	1.5	2	7	24	7	SL, G, Protective Eyewear, R-Aerial
	WP	80	70506-183	Aerial, Ground, Handheld, Chemigation	1.6	2	7	24	7	SL, G
Carrot (including tops)	DF	75	ID080012; OR170003; OR130003; WA030030	Aerial, Ground, Handheld, Chemigation	1.5	10	7	24-48	NS	SL, G, Protective Eyewear-WA030030
	FC	37	OR090016; WA090020	Aerial, Ground, Handheld,	1.5	2	7	24	NS	SL, G
9. Cucurbit Vegetables (Cantaloupe, Cucumber, Gourd, Pumpkin, Squash, Melons, and Squash)	DF	75	1001-77; 70506-234	Aerial, Ground, Handheld, Chemigation	2.25	2	7	24	5	SL, G
	FC	37	62719-396; 70506-194	Aerial, Ground, Handheld, Chemigation	2.4	2	7	24	5	SL, G
	WP	80	70506-183	Aerial, Ground, Handheld, Chemigation	2.4	10	7	24	5	SL, G
Chard, Swiss	DF	75	OR020030; OR130003; WA020028; WA130003	Aerial, Ground, Handheld,	1.5	2	7	24	NS	SL, G
	FC	37	OR090016; WA090020	Aerial, Ground, Handheld,	1.5	2	7	24	NS	SL, G

Table D-1. Summary of Use Directions for Registered Uses of Mancozeb - Foliar										
Crop/ Use Site	Formulation <sup>1</sup>	% AI	Registration Number	Application Type and Equipment	Application Rate (lb. ai/A)	Gallons of Water/Acre	Retreatment Interval (RTI; days)	Restricted Entry Interval (REI)	Pre-Harvest Interval (PHI; days)	Personal Protective Equipment (PPE) <sup>2</sup>
Coriander	DF	75	OR020030; OR130003; WA020028; WA130003	Aerial, Ground, Handheld,	1.5	2	7	24	NS	SL, G
	FC	37	OR090016; WA090020	Aerial, Ground, Handheld,	1.5	2	7	24	NS	SL, G
Corn, Sweet	DF	75	70506-234	Aerial, Ground, Handheld, Chemigation	1.13	2	4	24	7 to 40	SL, G
	FC	37	70506-194; 62719-396	Aerial, Ground, Handheld, Chemigation	1.2	2	4	24	7 to 40	SL, G
	WP	80	70506-183	Aerial, Ground, Handheld, Chemigation	1.2	2	4	24	7 to 40	SL, G
Cranberry	DF	75	70506-234	<b>Aerial, Ground, Chemigation</b>	<b>4.5</b>	<b>2</b>	<b>7</b>	<b>24</b>	<b>30</b>	<b>SL, G</b>
	FC	37	70506-194; 62719-396	<b>Aerial, Ground, Chemigation</b>	<b>4.8</b>	<b>2</b>	<b>7</b>	<b>24</b>	<b>30</b>	<b>SL, G</b>
	WP	80	70506-183	<b>Aerial, Ground, Chemigation</b>	<b>4.8</b>	<b>2</b>	<b>7</b>	<b>24</b>	<b>30</b>	<b>SL, G</b>
Dill	DF	75	OR020030; OR130003; WA130003; WA020028	Aerial, Ground, Handheld	1.5	2	7	24	NS	SL, G
	FC	37	OR090016; WA090020	Aerial, Ground, Handheld	1.5	2	7	24	NS	SL, G
Endive (Escarole)	DF	75	OR020030; OR130003; WA130003; WA020028	Aerial, Ground, Handheld	1.5	2	7	24	NS	SL, G
	FC	37	OR090016; WA090020	Aerial, Ground, Handheld,	1.5	2	7	24	NS	SL, G
Fennel	DF	75	70506-234	Aerial, Ground, Handheld, Chemigation	1.5	2	7	24	14	SL, G
	FC	37	70506-194; 62719-396	Aerial, Ground, Handheld, Chemigation	1.6	2	7	24	14	SL, G
	WP	80	70506-183	Aerial, Ground, Handheld, Chemigation	1.6	2	7	24	14	SL, G
Garden Beet	DF	75	OR020030; OR130003; WA020028	Aerial, Ground, Handheld	1.5	2	7	24	NS	SL, G
	FC	37	OR090016; WA090020	Aerial, Ground, Handheld	1.5	2	7	24	NS	SL, G

Table D-1. Summary of Use Directions for Registered Uses of Mancozeb - Foliar										
Crop/ Use Site	Formulation <sup>1</sup>	% AI	Registration Number	Application Type and Equipment	Application Rate (lb. ai/A)	Gallons of Water/Acre	Retreatment Interval (RTI; days)	Restricted Entry Interval (REI)	Pre-Harvest Interval (PHI; days)	Personal Protective Equipment (PPE) <sup>2</sup>
Garlic	DF	75	70506-234	Aerial, Ground, Handheld, Chemigation	2.25	2	7	24	7	SL, G
	FC	37	70506-194; 62719-396	Aerial, Ground, Handheld, Chemigation	2.4	2	7	24	7	SL, G
	WP	80	70506-183	Aerial, Ground, Handheld, Chemigation	2.4	2	7	24	7	SL, G
Ginseng	DF	75	70506-234	Aerial, Ground, Handheld, Chemigation	1.5	2	7	24	30	SL, G
	SC	75	34704-1120	Aerial, Ground, Handheld, Chemigation	1.5	2	7	24	30	SL, G, Protective Eyewear
	WP	80	70506-183	Aerial, Ground, Handheld, Chemigation	1.6	2	7	24	30	SL, G
Leafy Brassica Greens	DF	75	WA020028	Aerial, Ground, Handheld	1.5	2	7	24	NS	SL, G
	FC	37	WA090020	Aerial, Ground, Handheld	1.5	2	7	24	NS	SL, G
Leek	DF	75	OR020030; OR130003; WA020028; WA130003	Aerial, Ground, Handheld	1.5	2	7	24	NS	SL, G
	FC	37	OR090016; WA090020	Aerial, Ground, Handheld	1.5	2	7	24	NS	SL, G
Lettuce	DF	75	70506-234; 90332-2; OR020030; OR130003; WA020028; WA130003	Aerial, Ground, Handheld, Chemigation	1.88	2	7	24	10 to 14	SL, G, R-Aerial
	FC	37	62719-396; 70506-194; OR090016; WA090020	Aerial, Ground, Handheld, Chemigation	1.6	2	7	24	10 to 14	SL, G, R-Aerial
	WP	80	70506-183	Aerial, Ground, Handheld, Chemigation	1.6	2	7	24	10 to 14	SL, G
Onion	DF	75	70506-234; OR130003; OR020030; WA020028; WA130003	Aerial, Ground, Handheld, Chemigation	2.25	2	7	24	7	SL, G
	FC	37	62719-396; 70506-194; OR090016; WA090020	Aerial, Ground, Handheld, Chemigation	2.4	2	7	24	7	SL, G

Table D-1. Summary of Use Directions for Registered Uses of Mancozeb - Foliar										
Crop/ Use Site	Formulation <sup>1</sup>	% AI	Registration Number	Application Type and Equipment	Application Rate (lb. ai/A)	Gallons of Water/Acre	Retreatment Interval (RTI; days)	Restricted Entry Interval (REI)	Pre-Harvest Interval (PHI; days)	Personal Protective Equipment (PPE) <sup>2</sup>
	WP	80	70506-183	Aerial, Ground, Handheld, Chemigation	2.4	2	7	24	7	SL, G
Parsley	DF	75	OR130003; OR020030; WA020028; WA130003	Aerial, Ground, Handheld	1.5	2	7	24	NS	SL, G
	FC	37	OR090016; WA090020	Aerial, Ground, Handheld	1.5	2	7	24	NS	SL, G
Parsnip	DF	75	OR130003; OR020030; WA020028; WA130003	Aerial, Ground, Handheld	1.5	2	7	24	NS	SL, G
	FC	37	OR090016; WA090020	Aerial, Ground, Handheld	1.5	2	7	24	NS	SL, G
Pepper	DF	75	70506-234	Aerial, Ground, Handheld, Chemigation	2.4	2	7	24	7	SL, G, R-Aerial
	FC	37	70506-194; 62719-396	Aerial, Ground, Handheld, Chemigation	2.4	2	7	24	7	SL, G, R-Aerial
	WP	80	70506-183	Aerial, Ground, Handheld, Chemigation	1.6	2	7	24	7	SL, G
Plantain	DF	75	70506-234	Aerial, Ground, Handheld, Chemigation	2.25	2	14	24	0	SL, G
	FC	37	70506-194; 62719-396	Aerial, Ground, Handheld, Chemigation	2.4	2	14	24	0	SL, G
	WP	80	70506-183	Aerial, Ground, Handheld, Chemigation	2.4	2	14	24	0	SL, G
Shallot	DF	75	70506-234	Aerial, Ground, Handheld, Chemigation	2.25	2	7	24	7	SL, G
	FC	37	70506-194; 62719-396	Aerial, Ground, Handheld, Chemigation	2.4	2	7	24	7	SL, G
	WP	80	70506-183	Aerial, Ground, Handheld, Chemigation	2.4	2	7	24	7	SL, G

<b>Table D-1. Summary of Use Directions for Registered Uses of Mancozeb - Foliar</b>										
<b>Crop/ Use Site</b>	<b>Formulation<sup>1</sup></b>	<b>% AI</b>	<b>Registration Number</b>	<b>Application Type and Equipment</b>	<b>Application Rate (lb. ai/A)</b>	<b>Gallons of Water/Acre</b>	<b>Retreatment Interval (RTI; days)</b>	<b>Restricted Entry Interval (REI)</b>	<b>Pre-Harvest Interval (PHI; days)</b>	<b>Personal Protective Equipment (PPE)<sup>2</sup></b>
Spinach	DF	75	OR020030; OR130003; WA020028; WA130003	Aerial, Ground, Handheld	1.5	2	7	24	NS	SL, G, R-Aerial
	FC	37	OR090016; WA090020	Aerial, Ground, Handheld	1.5	2	7	24	NS	SL, G, R-Aerial
Tobacco	DF	75	OH020006; PA080001; MD080004; MO080004; NC080002; OH080003; SC080004; TN080007; VA080004; CT120001; CT140002; IN120001; MO120007; OH120001; PA120002; SC120006; VA120004; KY110033; MA150001; TN140003; CT140001; KY080005; NC080003; TN080009; VA080005	Aerial, Ground, Handheld, Chemigation	1.96	100	5 to 7	24	21 to 30	SL, G
Tomato	DF	75	70506-234	Aerial, Ground, Handheld, Chemigation	2.25	2	7	24	5	SL, G
	SC	75	34704-1120	Aerial, Ground, Handheld, Chemigation	2.25	2	7	24	5	SL, G, Protective Eyewear
	WP	80	70506-183	Aerial, Ground, Handheld, Chemigation	2.4	2	7	24	5	SL, G
<b>High Acreage Field Crop<sup>3</sup></b>										
Barley	DF	75	70506-234	Aerial, Ground, Handheld, Chemigation	1.5	2	7	24	26	SL, G
	FC	37	70506-194; 62719-396	Aerial, Ground, Handheld, Chemigation	1.6	2	7	24	26 to 46	SL, G
	WP	80	70506-183	Aerial, Ground, Handheld, Chemigation	1.6	2	7	24	26 to 46	SL, G
Corn, Field/Pop	DF	75	70506-234	Aerial, Ground, Handheld, Chemigation	1.13	2	4	24	7 to 40	SL, G
	FC	37	70506-194; 62719-396	Aerial, Ground, Handheld, Chemigation	1.2	2	4	24	7 to 40	SL, G

Table D-1. Summary of Use Directions for Registered Uses of Mancozeb - Foliar										
Crop/ Use Site	Formulation <sup>1</sup>	% AI	Registration Number	Application Type and Equipment	Application Rate (lb. ai/A)	Gallons of Water/Acre	Retreatment Interval (RTI; days)	Restricted Entry Interval (REI)	Pre-Harvest Interval (PHI; days)	Personal Protective Equipment (PPE) <sup>2</sup>
	WP	80	70506-183	Aerial, Ground, Handheld, Chemigation	1.2	2	4	24	7 to 40	SL, G
Peanuts	DF	75	70506-234	Aerial, Ground, Handheld	1.5	2	7	24	14	SL, G
	FC	37	70506-194; 62719-396	Aerial, Ground, Handheld, Chemigation	1.6	2	7	24	14	SL, G
	WP	80	70506-183	Aerial, Ground, Handheld, chemigation	1.6	2	7	24	14	SL, G
Potato	DF	75	70506-234; 90332-2	Aerial, Ground, Handheld, Chemigation	1.5	2	3 to 5	24	3 to 14	SL, G
				Dip Treatment	0.0188 lb/gal	50	NS	24	NS	
	SC	75	34704-1120	Aerial, Ground, Handheld, Chemigation	1.5	2	3	24	3 to 14	SL, G, Protective Eyewear
				Dip Treatment	0.0188 lb/gal	50	NS		NS	SL, G, Protective Eyewear, R
	WP	80	70506-183	Aerial, Ground, Handheld, Chemigation	1.68	2	5	24	3 to 14	SL, G
				Dip Treatment	0.02 lb/gal	50	NS		NS	
Rye, Wheat, Triticale, Oats	DF	75	70506-234	Aerial, Ground, Handheld, Chemigation	1.5	3	7	24	26	SL, G
	FC	37	70506-194; 62719-396	Aerial, Ground, Handheld, Chemigation	1.6	2	7	24	26-46	SL, G
	WP	80	70506-183	Aerial, Ground, Handheld, Chemigation	1.6	2	7	24	26-46	SL, G
Sugar Beet	DF	75	70506-234; OR020030; OR130003	Aerial, Ground, Handheld, Chemigation	1.5	2	7	24	14	SL, G
	FC	37	70506-194; 62719-396; OR090016	Aerial, Ground, Handheld, Chemigation	1.6	2	7	24	14	SL, G
	WP	80	70506-183	Aerial, Ground, Handheld, Chemigation	1.6	2	7	24	14	SL, G

<b>Table D-1. Summary of Use Directions for Registered Uses of Mancozeb - Foliar</b>										
<b>Crop/ Use Site</b>	<b>Formulation<sup>1</sup></b>	<b>% AI</b>	<b>Registration Number</b>	<b>Application Type and Equipment</b>	<b>Application Rate (lb. ai/A)</b>	<b>Gallons of Water/Acre</b>	<b>Retreatment Interval (RTI; days)</b>	<b>Restricted Entry Interval (REI)</b>	<b>Pre-Harvest Interval (PHI; days)</b>	<b>Personal Protective Equipment (PPE)<sup>2</sup></b>
<b>Turf (Sod, Golf Course)<sup>3</sup></b>										
Sod	DF	75	70506-234; 1001-77	Aerial, Ground, Handheld	17.4	44	10	24	5	SL, G
	SC	75	34704-1120	Aerial, Ground, Handheld, Chemigation	17.4	5	10	24	5	SL, G, R
Golf Course (Greens and Tees)	DF	75	70506-234; 1001-77	Aerial, Ground, Handheld, Chemigation	17.4	44	10	24	NS	SL, G
	SC	75	34704-1120	Aerial, Ground, Handheld, Chemigation	17.4	5	10	24	NS	SL, G, Protective Eyewear
	WSP	64	58185-31	Ground, Handheld	10.45	218	NS	NS	NS	SL, G, R, Headgear, WSP
Golf Course (Fairways)/Professional/Industrial/Institutional	DF	75	70506-234; 1001-77	Aerial, Ground, Handheld, Chemigation	17.4	44	10	24	NS	SL, G
	SC	75	34704-1120	Aerial, Ground, Handheld, Chemigation	17.4	5	10	24	NS	SL, G, Protective Eyewear
	WSP	64	58185-31	Ground, Handheld	10.45	218	NS	NS	NS	SL, G, R, Headgear, WSP
	WSP	64	58185-31	Ground, Handheld	10.45	218	NS	NS	NS	SL, G, R, Headgear, WSP
<b>Nursery or Greenhouse Vegetables and Ornamentals; Landscaping, plants/flowers/trees/shrubs<sup>3</sup></b>										
Ornamentals: Indoor/Outdoor	DF	75	1001-77; 70506-234	Aerial, Ground, Handheld, Chemigation	1.5	10; 5 (aerial)	7	24	NS	SL, G
	FC	37	70506-194; 62719-396	Aerial, Ground, Handheld, Chemigation	1.2	100	7	24	NS	SL, G
	WP	80	70506-183	Aerial, Ground, Handheld, Chemigation	1.6	100	7	24	NS	SL, G
	WSP	64	58185-31	Ground, Handheld	1.44	75	7	24	NS	SL, G, R, Headgear, WSP
Cut Flowers	FC	37	62719-396	Aerial, Ground, Handheld, Chemigation	1.2	100	7	24	NS	SL, G
	WSP	64	58185-31	Ground, Handheld	2.05	100	7	24	NS	SL, G, R, Headgear, WSP

Crop/ Use Site	Formulation <sup>1</sup>	% AI	Registration Number	Application Type and Equipment	Application Rate (lb. ai/A)	Gallons of Water/Acre	Retreatment Interval (RTI; days)	Restricted Entry Interval (REI)	Pre-Harvest Interval (PHI; days)	Personal Protective Equipment (PPE) <sup>2</sup>
Vegetable Transplants (Cucumbers, Fennel, Melons, Squash, Tomatoes)	DF	75	1001-77	Aerial, Ground, Handheld Chemigation	2.25	200	7 to 10	24	5 to 14	SL, G

<sup>1</sup> DF = dry flowable. FC = flowable concentrate. WP = wettable powder. WSP = water-soluble packet.

<sup>2</sup> PPE: SL, G = single layer, gloves. R = respirator. Headgear = chemical-resistant headgear. WSP = water-soluble packet.

<sup>3</sup> Occupational handler category.

<sup>4</sup> **Bold text** = highest rates used for assessment.

Use Site	Amount Seed Treated (Commercial)	Amount Seed Treated (On Farm)	lb seed planted/day	Form <sup>1</sup>	%AI	Reg. No	Equipment	lb ai/lb seed	Personal Protective Equipment (PPE) <sup>2</sup>
Cereal Grains (Barley)	360,000 (Wheat surrogate)	19,600	19,600	DF	75	70506-234	Seed Treatment, Commercial	0.0315	SL, G
				FC	37	62719-396	Seed Treatment, Commercial	0.00209	SL, G
				EC	37	70506-345	Seed Treatment, On Farm	0.00209	SL, G, R
				D	10	400-558	Seed Treatment, On Farm	0.00131	SL, G, R
				WP	80	70506-183	Seed Treatment, Commercial (Planter Box Only)	0.0021	SL, G, R
Cereal Grains (Oats)	360000 (Wheat surrogate)	18,000	18,000	DF	75	70506-234	Seed Treatment, Commercial	0.0473	SL, G
				FC	37	62719-396	Seed Treatment, Commercial	0.00313	SL, G
				EC	37	70506-345	Seed Treatment, On Farm	0.00313	SL, G, R
				D	10	400-558	Seed Treatment, On Farm	0.00197	SL, G, R
				WP	80	70506-183	Seed Treatment, Commercial (Planter Box Only)	0.00315	SL, G, R
Cereal Grains (Rye)	360000 (Wheat surrogate)	18,000	18,000	DF	75	70506-234	Seed Treatment, Commercial	0.027	SL, G
				FC	37	62719-396	Seed Treatment, Commercial	0.00178	SL, G
				EC	37	70506-345	Seed Treatment, On Farm	0.00178	SL, G, R
				D	10	400-558	Seed Treatment, On Farm	0.00113	SL, G, R
				WP	80	70506-183	Seed Treatment, Commercial (Planter Box Only)	0.0018	SL, G, R
Cereal Grains (Sorghum)	360000 (Wheat surrogate)	960	960	DF	75	70506-234	Seed Treatment, Commercial	0.0338	SL, G
				FC	37	70506-194; 62719-396	Seed Treatment, Commercial	0.00225	SL, G
				EC	37	70506-345	Seed Treatment, On Farm	0.00225	SL, G, R
				D	10	400-558	Seed Treatment, On Farm	0.00094	SL, G, R

Table D-2. Summary of Use Directions for Registered Uses of Mancozeb – Seed Treatment.									
Use Site	Amount Seed Treated (Commercial)	Amount Seed Treated (On Farm)	lb seed planted/day	Form <sup>1</sup>	%AI	Reg. No	Equipment	lb ai/lb seed	Personal Protective Equipment (PPE) <sup>2</sup>
				WP	80	70506-183	Seed Treatment, Commercial	0.00225	SL, G, R
Cereal Grains (Wheat, Triticale)	360000 (Wheat surrogate)	31,400 (wheat); 21,800 (triticale)	31,400	DF	75	70506-234	Seed Treatment, Commercial	0.0248	SL, G
				FC	37	62719-396	Seed Treatment, Commercial	0.00163	SL, G
				EC	37	70506-345	Seed Treatment, On Farm	0.00163	SL, G, R
				D	10	400-558	Seed Treatment, On Farm	0.00103	SL, G, R
				WP	80	70506-183	Seed Treatment, Commercial (Planter Box Only)	0.00165	SL, G, R
Cereal Grains (Corn)	339,500	5,910	5,910	DF	75	70506-234	Seed Treatment, Commercial	0.0405	SL, G
				FC	37	70506-194; 62719-396	Seed Treatment, Commercial	0.00269	SL, G, R (70506-194)
				EC	37	70506-345	Seed Treatment, On Farm	0.00269	SL, G, R
				WP	80	70506-183	Seed Treatment, Commercial	0.0027	SL, G, R
Cotton	125,000	3,780	3,780	DF	75	70506-234	Seed Treatment, Commercial	0.045	SL, G
				FC	37	70506-194; 62719-396	Seed Treatment, Commercial	0.003	SL, G, R (70506-194)
				EC	37	70506-345	Seed Treatment, On Farm	0.003	SL, G, R
				WP	80	70506-183	Seed Treatment, Commercial	0.003	SL, G, R
Flax	125,000 (Canola Surrogate)	3,780	4,000	DF	75	70506-234	Seed Treatment, Commercial	0.0533	SL, G
				FC	37	70506-194; 62719-396	Seed Treatment, Commercial	0.0533	SL, G, R (70506-194)
				EC	37	70506-345	Seed Treatment, On Farm	0.00353	SL, G, R
				WP	80	70506-183	Seed Treatment, Commercial	0.00355	SL, G, R
Peanuts	126,000	18,300	18,300	DF	75	70506-234	Seed Treatment, Commercial	0.12	SL, G
				FC	37	70506-194; 62719-396	Seed Treatment, Commercial	0.008	SL, G, R (70506-194)
				EC	37	70506-345	Seed Treatment, On Farm (Shelled)	0.008	SL, G, R
				WP	80	70506-183	Seed Treatment, Commercial (Shelled)	0.008	SL, G, R
Potato	800,000	425,000	425,000	D	8	2935-539	Seed Treatment, Commercial/On Farm	0.0008	SL, G, R
				FC	37	70506-194; 62719-396	Seed Treatment, Commercial	0.000781	SL, G, R
				EC	37	70506-345	Seed Treatment, On Farm	0.000781	SL, G, R
Rice	302,500	31,300	31,300	DF	75	70506-234	Seed Treatment, Commercial	0.027	SL, G
				FC	37	70506-194; 62719-396	Seed Treatment, Commercial	0.002	SL, G, R (70506-194)
				EC	37	70506-345	Seed Treatment, On Farm	0.002	SL, G, R
				D	10	400-558	Seed Treatment, On Farm	0.00125	SL, G, R

Table D-2. Summary of Use Directions for Registered Uses of Mancozeb – Seed Treatment.									
Use Site	Amount Seed Treated (Commercial)	Amount Seed Treated (On Farm)	lb seed planted/day	Form <sup>1</sup>	%AI	Reg. No	Equipment	lb ai/lb seed	Personal Protective Equipment (PPE) <sup>2</sup>
				WP	80	70506-183	Seed Treatment, Commercial	0.032	SL, G, R
Safflower	80,000 (Sunflower surrogate)	2,800	2,800	DF	75	70506-234	Seed Treatment, Commercial	0.015	SL, G
				FC	37	70506-194; 62719-396	Seed Treatment, Commercial	0.001	SL, G
				EC	37	70506-345	Seed Treatment, On Farm	0.001	SL, G, R
				D	10	400-558	Seed Treatment, On Farm	0.00094	SL, G, R
				WP	80	70506-183	Seed Treatment, Commercial	0.001	SL, G, R
Small seeded vegetables (Tomato)	3,000	87	81	DF	75	70506-234	Seed Treatment, Commercial	0.06	SL, G
				FC	37	70506-194; 62719-396	Seed Treatment, Commercial	0.004	SL, G, R (70506-194)
				EC	37	70506-345	Seed Treatment, On Farm	0.004	SL, G, R
				WP	80	70506-183	Seed Treatment, Commercial	0.004	SL, G, R

<sup>1</sup> DF = dry flowable. FC = flowable concentrate. EC = emulsifiable concentrate. WP = wettable powder. D = dust.

<sup>2</sup> PPE: SL, G = single layer, gloves. R = respirator.

## Appendix E. Chemical-Specific Data

### Review of Turf Transferable Studies

This study measured TTR of mancozeb and ETU, a breakdown product, following groundboom sprayer application of Dithane F-45 fungicide to turf. This study was conducted at three test sites which were located in Creedmore, North Carolina, Hamburg, Pennsylvania and Madera, California. Two plots were established at each site and the control plots were located 189, 313 and > 450 feet away from the treated plots. Turf varieties treated included Bermudagrass in NC, Kentucky Bluegrass in PA and Tall Fescue in CA. The turf had been mowed to 1.25" in NC, 1" in PA and 2" in CA one or two days prior to application. The turf was mowed again prior to sampling on post-application day five in NC, after sampling on post-application day ten in PA and on post-application day eight in CA. Weather data were collected and significant rainfall occurred 3 days after treatment in NC (0.43") and 12 days after treatment in PA (0.15"). Irrigation occurred only at the CA site (four times for a total of 2.52 inches). The application rates (lb ai/1,000 ft<sup>2</sup>) were 0.37 for NC, 0.24 for PA and 0.26 for CA and only one application was made. The maximum label application rate is 0.4 lb ai/1,000 ft<sup>2</sup> per application and repeat applications at 5-14-day intervals are permitted throughout the growing season. The applications were made with a spray volume of 2 gallons per 1,000 ft<sup>2</sup> and a surfactant was used. The chemical-specific TTR data were collected with the Modified California Roller Method.

HED assumed first-order kinetics to generate dissipation curves for mancozeb and ETU. Most notably, average day 0 residues, predicted day 0 residues, dissipation rates, and half-lives have been utilized from this model.

Mancozeb: The predicted initial mancozeb residue values on day 0 were: 0.150 µg/cm<sup>2</sup> at the California site; 0.101 µg/cm<sup>2</sup> at the North Carolina site; and 0.049 µg/cm<sup>2</sup> at the Pennsylvania site. The study results were corrected to account for the difference in the study application rate at each site vs. the registered product application rate (17.4 lb ai/acre). A summary of the key inputs/results for TTR data is presented in Table 5.2.1 below.

Statistic	CA site	NC site	PA site
Study Target Application Rate (lb ai/A)	11.3	16.1	10.5
Measured Average Day 0 Residue (µg/cm <sup>2</sup> )	0.1883	0.1525	0.0774
Linear Regression Predicted Day 0 Residue (µg/cm <sup>2</sup> )	0.150	0.101	0.049
Slope	-0.301	-0.234	-0.103
Half-Life (days)	2.3	3.0	6.7
R <sup>2</sup>	0.91	0.9266	0.7151

ETU: ETU residues ranged from below the limit of quantification (LOQ) (0.0018 µg/cm<sup>2</sup>) to 0.0195 µg/cm<sup>2</sup> across all three sites. In Pennsylvania, there was only one sample with a residue > LOQ. However, the control sample on that day was contaminated. For almost half of the samples collected in North Carolina, ETU residues were above the LOQ (it should be noted that eight samples in NC could not be quantified due to an interfering peak). For 50 percent of the samples collected in California, ETU residues were above the LOQ. However, in both North Carolina and California, a large majority of ETU residues approximately equaled the controls. Also, it is noteworthy that in California, ETU residues

were near the LOQ until day 4 when they increased to 0.0195  $\mu\text{g}/\text{cm}^2$ . From DAT-5 through DAT-14, however, TTR residues were < LOQ.

A regression analysis was not conducted for ETU at any of the test sites as the residues do not follow a typical linear regression; the results fluctuate up and down throughout the sampling periods for the NC and CA sites (the PA site results were all < LOQ throughout the study). As a conservative measure, the highest residue was used as the “day 0” residue; identified as 0.0195  $\mu\text{g}/\text{cm}^2$ . The study results were corrected to account for the difference in the study application rate (11.3 lbs ai/acre at the CA site) vs. the registered product application rate (17.4 lb ai/acre). A summary of the application rates and highest measured residues is provided in Table 5.2.2 below.

Statistic	CA site	NC site	PA site
Study Target Application Rate (lb ai/A)	11.3	16.1	10.5
Measured Average Day 0 Residue ( $\mu\text{g}/\text{cm}^2$ )	0.0020	0.0027	all < LOQ
Highest Measured Residue ( $\mu\text{g}/\text{cm}^2$ )	<b>0.0195</b> <b>(4 DAT)</b>	0.0026 (0.33 DAT)	all < LOQ
Highest Measured Residue - Adjusted ( $\mu\text{g}/\text{cm}^2$ )	<b>0.031<sup>2</sup></b>	-	-

<sup>1</sup> DAT = day after treatment. Highest residue across sites in **bold**.

<sup>2</sup> Highest measured residue (0.0195  $\mu\text{g}/\text{cm}^2$ ) x Label Application Rate (17.4 lb ai/A) ÷ Study Application Rate (11.3 lb ai/A)

## **Review of Dislodgeable Foliar Residue Studies**

### ***Studies Determined Acceptable for Use in Risk Assessment***

#### ***Dissipation of Mancozeb Applied to Greenhouse Tomatoes, MRID 44961701 (D459490, D. Carter, 12/07/2020)***

This study measured mancozeb and ETU DFRs following handgun sprayer application of Dithane DF to greenhouse tomatoes. Two applications of 2.3 lb ai/acre were made 7 days apart with a spray volume of 71 gallons per acre (GPA) and with a label recommended surfactant (Latron B-1976). This study was conducted at two identical green houses at a site in North Carolina. One green house was used for treated plants and one was used for untreated controls. The tomatoes were grown in rockwool cubes serviced by injectors that provided nutrients and water. The treated greenhouse average daily temperatures ranged from 64° to 77° F and the humidity ranged from 81 to 84 percent. The untreated greenhouse temperatures ranged from 64° to 78° F and the humidity ranged from 53 to 90%.

Triplicate DFR samples were collected out to 35 days using the Iwata method to yield a total double side leaf surface area of 400  $\text{cm}^2$  per sample. The LOQs derived from method validation were 0.005  $\mu\text{g}/\text{cm}^2$  for mancozeb and 0.0025  $\mu\text{g}/\text{cm}^2$  for ETU. Quality control data indicated good field and lab recovery. The average laboratory recovery was 101 ± 6.9 percent (n = 18) for mancozeb and 105 ± 6.4 percent (n = 15) for ETU. The fortification levels ranged from the LOQ to 16x LOQ for mancozeb and from the LOQ to 920x LOQ for ETU. The field recoveries were above 90 percent at both levels of fortification (mancozeb: 0.025, 0.50  $\mu\text{g}/\text{cm}^2$ ; ETU: 0.0125, 0.050  $\mu\text{g}/\text{cm}^2$ ). The mancozeb field fortification samples were stored for 127 to 155 days while the ETU field fortification samples were stored for 1 to 2 days which is similar to the storage time for the samples.

All of the mancozeb results were 68x or more above the LOQ at all sampling intervals while some of the controls had low residues that were a maximum of 0.5 percent of the treated sample residues. The ETU results starting at day 21 were at or near the LOQ and only the DAT 1 control had quantifiable residues that were almost equal to the treated sample and the cause is unknown. The ETU residues appeared to dissipate in a more rapid first phase followed by a slower second phase. The only major concern with this study is that the total amount of Dithane DF applied (2.3 + 2.3 lb ai/acre) was less than the yearly label maximum (16.8 lb ai/acre) because only two applications were made instead of a possible seven. The measured DFR did indicate some mancozeb residue accumulation because it rose from 1.9 ug/cm<sup>2</sup> on DAT 0 following the first application to 5.1 ug/cm<sup>2</sup> on DAT 0 following the second application.

The results of this study are summarized in Table E-3.

Statistic	Mancozeb	ETU
Study Application Rate (lb ai/A)	2.3	
Measured Average Day 0 Residue (µg/cm <sup>2</sup> )	5.2917	0.0128
Linear Regression Predicted Day 0 Residue (µg/cm <sup>2</sup> )	3.718	0.010
Slope	-0.070	-0.036
Half-Life (days)	9.8	19.2
R <sup>2</sup>	0.91	0.60

***Dissipation of Mancozeb Applied to Field Tomatoes, MRID 44959603 (D459489, D. Carter, 12/07/2020)***

This study measured dislodgeable foliar residues of mancozeb and ETU following groundboom application of Dithane DF to field tomatoes. This study was conducted at two sites: one located in Florida and one located in California. Two applications, 5 days apart (CA) and 7 days apart (FL), were made at application rates of 1.7 lb ai/acre (CA) and 2.5 lb ai/acre (FL). This study was conducted at two sites: one located in Florida and one located in California. Each site had one treated plot which was divided into three subplots for sampling and one untreated plot which was located 135 or 200 feet away from the treated plot. Weather conditions were recorded and 0.18 inches of total rainfall occurred in California during the study while 10.6" inches of rain fell in Florida. The most significant rainfall in Florida (7.0") occurred on day three after the second application. The spray volume was 50 - 55 GPA and Latron B-1956 surfactant was used. The tomato plants at the second application in California were 18" tall, blooming with 1" diameter fruit. The plants in Florida were 40" tall with 3-4" fruit. This followed label recommendations.

Triplicate DFR samples were collected out to 35 days using the Iwata method to yield a total double side leaf surface area of 400 cm<sup>2</sup> per sample. The LOQs as derived from method validation were 0.005 ug/cm<sup>2</sup> for mancozeb and 0.0025 ug/cm<sup>2</sup> for ETU. The average laboratory recoveries were 101 percent for mancozeb and 82 percent for ETU and did not vary with respect to the fortification levels which ranged from 5X LOQ to SOX LOQ. The field recoveries for both mancozeb and ETU were above 90 percent at both levels of fortification (0.0250, 0.50 ug/cm<sup>2</sup> for mancozeb and 0.0125, 0.05 ug/cm<sup>2</sup> for ETU). The sample to analysis interval ranged from 291 to 362 days for mancozeb and 2 to 8 days for ETU. The field fortification samples were analyzed in conjunction with the field samples and indicated good storage stability.

All of the mancozeb results were 6X or more above the LOQ while some of the controls were up to 3X the LOQ. The control results for California were generally less than 1% of the treated sample results until DAT 21 and were a maximum of 8.5% on DAT 35. The control results for Florida were also less than 1.3% on all days except for DAT 35 when they were 7%. The ETU results up to DAT 1 in FL and DAT 7 in CA were above the LOQ and all the controls were less than the LOQ. This study generally complied with series 875 guidelines. The low ETU levels relative to the LOQ is the major limitation and reduces the accuracy of the dissipation rates particularly for the Florida site which was severely affected by rainfall.

The results of the study are summarized below. Due to the significant rainfall at the Florida site, only the California site was considered for use in this risk assessment.

Statistic	Mancozeb		ETU	
	CA	FL	CA	FL
Study Target Application Rate (lb ai/A)	1.7	2.5	1.7	2.5
Measured Average Day 0 Residue ( $\mu\text{g}/\text{cm}^2$ )	6.77	7.4	0.0092	0.0023
Linear Regression Predicted Day 0 Residue ( $\mu\text{g}/\text{cm}^2$ )	3.644	3.535	0.011	0.002
Slope	-0.110	-0.142	-0.191	-0.015
Half-Life (days)	6.3	4.9	3.6	46.8
R <sup>2</sup>	0.94	0.90	0.91	0.007

***Dissipation of Dislodgeable Foliar Residues of Mancozeb Applied to Grapes, MRID 44959601 (D459487, D. Carter, 12/07/2020)***

This study measured DFR of mancozeb and ETU following airblast application of Dithane DF to grapes. Two applications, 7 days apart, were made with application rates of 1.93 and 1.97 lb ai/acre to yield a total application of 3.9 lb ai/acre. The spray volume was 75 gallons per acre and Latron B-1956 surfactant was used. This study was conducted on one treated and one untreated plot at one site which was an established vineyard in the San Joaquin valley of California. The untreated plot was located over 300 feet south of the treated plot and the prevailing wind was from the northwest. Weather conditions were recorded and were normal for this region with no rain events during the study. The grapes were "past the version" stage at the first application and were "50-60 percent mature" at the second application. This is later than the label recommended timing (pre-bloom through bloom) and was chosen by the study author in order to have sufficient leaf area.

Triplicate DFR samples were collected out to 35 days using the Iwata method to yield a total double side leaf surface area of 400  $\text{cm}^2$  per sample. The LOQs were 0.005  $\mu\text{g}/\text{cm}^2$  for mancozeb and 0.0025  $\mu\text{g}/\text{cm}^2$  for ETU.

Field recoveries for mancozeb were  $93.5 \pm 9.5$  percent at 0.025  $\mu\text{g}/\text{cm}^2$  and  $87.2 \pm 8.5$  percent at 0.49  $\mu\text{g}/\text{cm}^2$ . Field recoveries for ETU were  $33.5 \pm 11.4$  percent at 0.0125  $\mu\text{g}/\text{cm}^2$  and  $52.4 \pm 12.5$  percent at 0.049  $\mu\text{g}/\text{cm}^2$ . The field fortification samples were analyzed in conjunction with the samples. Concurrent laboratory recoveries averaged 101 percent ( $n = 23$ ) for mancozeb and 81.7 ( $n = 16$ ) for ETU and were fairly consistent at the individual fortification levels of 0.005 to 12  $\mu\text{g}/\text{cm}^2$  for

mancozeb and 0.0025 to 0.49  $\mu\text{g}/\text{cm}^2$  for ETU. The ETU data were corrected for low field recovery by dividing the DFR results by the average field recovery factor of 0.43.

All of the mancozeb treated sample results were 500X or more above the LOQ while all the control results were below the LOQ. Several of the ETU results were 1-2X the LOQ and the DAT 21 control had low residues that were similar to the treated sample.

The results of the study are summarized below.

Statistic	Mancozeb	ETU
Study Application Rate (lb ai/A)	1.95	
Measured Average Day 0 Residue ( $\mu\text{g}/\text{cm}^2$ )	4.5360	0.0544
Linear Regression Predicted Day 0 Residue ( $\mu\text{g}/\text{cm}^2$ )	4.422	0.018
Slope	-0.039	-0.067
Half-Life (days)	18.0	10.4
R <sup>2</sup>	0.90	0.64

***Dissipation of Dislodgeable Foliar Residues of Mancozeb Applied to Apples, MRID 44959602 (D459488, D. Carter, 12/07/2020)***

This study measured dislodgeable foliar residues of mancozeb and ETU following airblast application of Dithane DF fungicide to apples. Two applications of 4.8 lb ai/acre were made 7 days apart with a spray volume of 125 gallons per acre and Latron B-1956 surfactant. This study was conducted at two sites: one near Alton, New York and one in Ephrata, Washington. Each site had one treated plot and one untreated plot. The untreated plots were located 480-650 feet away from the treated plots. Weather conditions were recorded and 5.77 inches of total rainfall occurred in New York during 16 rain events. Two rain events (0.43" and 0.71") occurred on the two application days, but reportedly after the applications had dried. No irrigation was applied in New York. In Washington, two rainfall events (0.58" on DAT = 3 and 0.02" on DAT = 25) occurred which did not coincide with an application day. Under tree sprinkler irrigation was applied, however, it reportedly did not wet the leaves. The trees at both sites had 2.5" fruit at the first application. This was later than label recommended timing for the high rate (pre-bloom/ bloom) application schedule and was done to ensure sufficient leaf area for sampling.

Triplicate DFR samples were collected out to 35 days using the Iwata method to yield a total double side leaf surface area of 400  $\text{cm}^2$  per sample. The LOQs were 0.005  $\mu\text{g}/\text{cm}^2$  for mancozeb and 0.0025  $\mu\text{g}/\text{cm}^2$  for ETU. The laboratory recoveries at the individual fortification levels ranged from 89 to 100.4 percent for mancozeb and 77.2 to 87.9 percent for ETU. The average field recoveries were 83 percent for mancozeb and 73 percent for ETU and did not vary greatly with respect to the fortification levels (mancozeb: 0.025, 0.50  $\mu\text{g}/\text{cm}^2$ ; ETD: 0.0125, 0.050  $\mu\text{g}/\text{cm}^2$ ). The field fortification samples were analyzed in conjunction with the field samples. The sample results were adjusted by a factor of 0.83 for mancozeb and 0.73 for ETU to correct for recovery less than 90 percent.

All of the mancozeb results were 200X or more above the LOQ while the ETU results were 2.5X or more above the LOQ. Control samples were found to have very low mancozeb residues near the LOQ which were less than 0.5 percent of the treated samples. ETU levels in the controls were below the LOQ. The major discrepancy of this study is that the total amount of Dithane DF applied (4.8 + 4.8 lb ai/acre) was

approximately half the yearly label maximum (19.2 lb ai/acre) because only two applications were made. It was not possible to make four applications because the applications were started later in the season to allow for adequate leaf sampling area.

The results of the study are summarized below.

Statistic	Mancozeb		ETU	
	NY	WA	NY	WA
Study Target Application Rate (lb ai/A)	5.0		5.0	
Measured Average Day 0 Residue ( $\mu\text{g}/\text{cm}^2$ )	15.8614	16.4544	0.224	0.0529
Linear Regression Predicted Day 0 Residue ( $\mu\text{g}/\text{cm}^2$ )	13.303	13.732	0.094	0.045
Slope	-0.074	-0.032	-0.090	-0.024
Half-Life (days)	9.4	13.7	7.7	28.7
R <sup>2</sup>	0.96	0.91	0.78	0.81

### ***Studies Considered and Determined Not Appropriate for Use in Risk Assessment***

***Dissipation of Mancozeb Applied to Tomatoes, MRID 42560201:*** This study is not recommended for use in risk assessment due to issues with significant rain at two of the sites; most of the ETU data were < LOQ. Therefore, a linear regression could not be completed. In addition, the total sampled leaf surface area was only 200 cm<sup>2</sup> which is not consistent with 875.2100 Guidelines.

***Mancozeb Dislodgeable Foliar Residue and Worker Reentry Studies on Grapes, MRID 41836901:*** This study is not recommended for use in risk assessment because of conflicting statements between the study reports and the field protocol regarding leaf punch diameters resulting in the total leaf surface area being unknown.

***Risk Assessment of Farm Worker Exposure to Dislodgeable Foliar Residue of Mancozeb and ETU, MRID 41833901:*** This study is not recommended for use in risk assessment due to differing extraction methods used for each replicate.

***Mancozeb Dislodgeable Foliar Residue and Worker Re-entry Studies on Tomatoes, MRID 41836902:*** This study is not recommended for use in risk assessment due to differing leaf sample sizes collected between sites as well as conflicting information on what the diameter of the leaf samples actually were.

## Appendix F. Occupational Risk Estimate Summary Tables

Table F-1. Occupational Handler Non-Cancer Exposure and Risk Estimates for Mancozeb - Foliar.								
Exposure Scenario	Crop or Target	Inhalation Unit Exposure ( $\mu\text{g}/\text{lb ai}$ ) <sup>1</sup>	Maximum Application Rate <sup>2</sup>	App Rate Unit	Area Treated or Amount Handled Daily <sup>3</sup>	Area Treated/Amount Handled Unit	Inhalation	
		Level of PPE or Engineering control					Dose ( $\text{mg}/\text{kg}/\text{day}$ ) <sup>4</sup>	MOE <sup>5</sup> (LOC = 10)
<b>Mixer/Loader</b>								
Dry Flowable, Aerial, Broadcast	Nursery (ornamentals, vegetables, trees, container stock)	8.96 [No-R]	2.25	lb ai/acre	60	acres	0.0151	1300
Dry Flowable, Aerial, Broadcast	Orchard/Vineyard	8.96 [No-R]	6.38	lb ai/acre	350	acres	0.25	76
Dry Flowable, Aerial, Broadcast	Sod	8.96 [No-R]	17.4	lb ai/acre	350	acres	0.683	28
Dry Flowable, Aerial, Broadcast	Field crop, typical	8.96 [No-R]	4.5	lb ai/acre	350	acres	0.176	110
Dry Flowable, Aerial, Broadcast	Field crop, high-acreage	8.96 [No-R]	1.5	lb ai/acre	1200	acres	0.201	95
Dry Flowable, Airblast, Broadcast	Nursery (ornamentals, vegetables, trees, container stock)	8.96 [No-R]	2.25	lb ai/acre	20	acres	0.00504	3800
Dry Flowable, Airblast, Broadcast	Orchard/Vineyard	8.96 [No-R]	6.38	lb ai/acre	40	acres	0.0286	670
Dry Flowable, Chemigation, Broadcast	Orchard/Vineyard	8.96 [No-R]	6.38	lb ai/acre	350	acres	0.25	76
Dry Flowable, Chemigation, Broadcast	Field crop, typical	8.96 [No-R]	4.5	lb ai/acre	350	acres	0.176	110
Dry Flowable, Chemigation, Broadcast	Field crop, high-acreage	8.96 [No-R]	1.5	lb ai/acre	350	acres	0.0588	320
Dry Flowable, Chemigation, Broadcast	Greenhouse (ornamentals, roses, cut flowers, container stock, vegetables)	8.96 [No-R]	2.25	lb ai/acre	60	acres	0.0151	1300
Dry Flowable, Chemigation, Broadcast	Nursery (ornamentals, vegetables, trees, container stock)	8.96 [No-R]	2.25	lb ai/acre	60	acres	0.0151	1300
Dry Flowable, Groundboom, Broadcast	Golf course (fairways, tees, greens)	8.96 [No-R]	17.4	lb ai/acre	40	acres	0.078	240
Dry Flowable, Groundboom, Broadcast	Field-grown ornamental crops	8.96 [No-R]	1.5	lb ai/acre	40	acres	0.00673	2800
Dry Flowable, Groundboom, Broadcast	Nursery (ornamentals, vegetables, trees, container stock)	8.96 [No-R]	2.25	lb ai/acre	60	acres	0.0151	1300
Dry Flowable, Groundboom, Broadcast	Greenhouse (ornamentals, roses, cut flowers, container stock, vegetables)	8.96 [No-R]	2.25	lb ai/acre	60	acres	0.0151	1300
Dry Flowable, Groundboom, Broadcast	Sod	8.96 [No-R]	17.4	lb ai/acre	80	acres	0.156	120

Table F-1. Occupational Handler Non-Cancer Exposure and Risk Estimates for Mancozeb - Foliar.								
Exposure Scenario	Crop or Target	Inhalation Unit Exposure ( $\mu\text{g}/\text{lb ai}$ ) <sup>1</sup>	Maximum Application Rate <sup>2</sup>	App Rate Unit	Area Treated or Amount Handled Daily <sup>3</sup>	Area Treated/Amount Handled Unit	Inhalation	
		Level of PPE or Engineering control					Dose ( $\text{mg}/\text{kg}/\text{day}$ ) <sup>4</sup>	MOE <sup>5</sup> (LOC = 10)
Dry Flowable, Groundboom, Broadcast	Orchard/Vineyard	8.96 [No-R]	6.38	lb ai/acre	40	acres	0.0286	670
Dry Flowable, Groundboom, Broadcast	Field crop, typical	8.96 [No-R]	4.5	lb ai/acre	80	acres	0.0404	470
Dry Flowable, Groundboom, Broadcast	Field crop, high-acreage	8.96 [No-R]	1.5	lb ai/acre	200	acres	0.0336	570
Dry Flowable, Dip Treatment,	Orchard/Vineyard	8.96 [No-R]	0.008	lb ai/gallon	1000	gallons solution	0.0286	670
Dry Flowable, Dip Treatment,	Field crop, typical	8.96 [No-R]	0.03	lb ai/gallon	1000	gallons solution	0.0404	470
Dry Flowable, Dip Treatment,	Field crop, high-acreage	8.96 [No-R]	0.02	lb ai/gallon	1000	gallons solution	0.0336	570
Liquid, Aerial, Broadcast	Nursery (ornamentals, vegetables, trees, container stock)	0.219 [No-R]	1.2	lb ai/acre	60	acres	0.000198	96000
Liquid, Aerial, Broadcast	Orchard/Vineyard	0.219 [No-R]	4.8	lb ai/acre	350	acres	0.0046	4200
Liquid, Aerial, Broadcast	Sod	0.219 [No-R]	17.4	lb ai/acre	350	acres	0.0166	1200
Liquid, Aerial, Broadcast	Field crop, typical	0.219 [No-R]	4.8	lb ai/acre	350	acres	0.0046	4200
Liquid, Aerial, Broadcast	Field crop, high-acreage	0.219 [No-R]	1.6	lb ai/acre	1200	acres	0.00525	3600
Liquid, Airblast, Broadcast	Nursery (ornamentals, vegetables, trees, container stock)	0.219 [No-R]	1.2	lb ai/acre	20	acres	0.0000658	290000
Liquid, Airblast, Broadcast	Orchard/Vineyard	0.219 [No-R]	4.8	lb ai/acre	40	acres	0.000525	36000
Liquid, Chemigation, Broadcast	Orchard/Vineyard	0.219 [No-R]	4.8	lb ai/acre	350	acres	0.0046	4200
Liquid, Chemigation, Broadcast	Sod	0.219 [No-R]	17.4	lb ai/acre	350	acres	0.0166	1200
Liquid, Chemigation, Broadcast	Field crop, typical	0.219 [No-R]	4.8	lb ai/acre	350	acres	0.0046	4200
Liquid, Chemigation, Broadcast	Field crop, high-acreage	0.219 [No-R]	1.6	lb ai/acre	350	acres	0.00154	12000
Liquid, Chemigation, Broadcast	Greenhouse (ornamentals, roses, cut flowers, container stock, vegetables)	0.219 [No-R]	1.2	lb ai/acre	60	acres	0.000198	96000
Liquid, Chemigation, Broadcast	Nursery (ornamentals, vegetables, trees, container stock)	0.219 [No-R]	1.2	lb ai/acre	60	acres	0.000198	96000

Exposure Scenario	Crop or Target	Inhalation Unit Exposure ( $\mu\text{g}/\text{lb ai}$ ) <sup>1</sup>	Maximum Application Rate <sup>2</sup>	App Rate Unit	Area Treated or Amount Handled Daily <sup>3</sup>	Area Treated/Amount Handled Unit	Inhalation	
		Level of PPE or Engineering control					Dose ( $\text{mg}/\text{kg}/\text{day}$ ) <sup>4</sup>	MOE <sup>5</sup> (LOC = 10)
Liquid, Groundboom, Broadcast	Golf course (fairways, tees, greens)	0.219 [No-R]	17.4	lb ai/acre	40	acres	0.0019	10000
Liquid, Groundboom, Broadcast	Field-grown ornamental crops	0.219 [No-R]	1.2	lb ai/acre	40	acres	0.000131	150000
Liquid, Groundboom, Broadcast	Nursery (ornamentals, vegetables, trees, container stock)	0.219 [No-R]	1.2	lb ai/acre	60	acres	0.000198	96000
Liquid, Groundboom, Broadcast	Greenhouse (ornamentals, roses, cut flowers, container stock, vegetables)	0.219 [No-R]	1.2	lb ai/acre	60	acres	0.000198	96000
Liquid, Groundboom, Broadcast	Sod	0.219 [No-R]	17.4	lb ai/acre	80	acres	0.00381	5000
Liquid, Groundboom, Broadcast	Orchard/Vineyard	0.219 [No-R]	4.8	lb ai/acre	40	acres	0.000525	36000
Liquid, Groundboom, Broadcast	Field crop, typical	0.219 [No-R]	4.8	lb ai/acre	80	acres	0.00105	18000
Liquid, Groundboom, Broadcast	Field crop, high-acreage	0.219 [No-R]	1.6	lb ai/acre	200	acres	0.000876	22000
Liquid, Dip Treatment,	Orchard/Vineyard	0.219 [No-R]	0.03	lb ai/gallon	1000	gallons solution	0.000525	36000
Liquid, Dip Treatment,	Field crop, typical	0.219 [No-R]	0.008	lb ai/gallon	1000	gallons solution	0.00105	18000
Liquid, Dip Treatment,	Field crop, high-acreage	0.219 [No-R]	0.02	lb ai/gallon	1000	gallons solution	0.000876	22000
Wettable Powder, Aerial, Broadcast	Nursery (ornamentals, vegetables, trees, container stock)	2.75 [No-R]	1.6	lb ai/acre	60	acres	0.0033	5800
Wettable Powder, Aerial, Broadcast	Orchard/Vineyard	2.75 [No-R]	4.8	lb ai/acre	350	acres	0.0578	330
Wettable Powder, Aerial, Broadcast	Field crop, typical	2.75 [No-R]	4.8	lb ai/acre	350	acres	0.0578	330
Wettable Powder, Aerial, Broadcast	Field crop, high-acreage	2.75 [No-R]	1.6	lb ai/acre	1200	acres	0.066	290
Wettable Powder, Airblast, Broadcast	Nursery (ornamentals, vegetables, trees, container stock)	2.75 [No-R]	1.6	lb ai/acre	20	acres	0.0011	17000
Wettable Powder, Airblast, Broadcast	Orchard/Vineyard	2.75 [No-R]	4.8	lb ai/acre	40	acres	0.0066	2900
Wettable Powder, Chemigation, Broadcast	Orchard/Vineyard	2.75 [No-R]	4.8	lb ai/acre	350	acres	0.0578	330
Wettable Powder, Chemigation, Broadcast	Field crop, typical	2.75 [No-R]	4.8	lb ai/acre	350	acres	0.0578	330

Table F-1. Occupational Handler Non-Cancer Exposure and Risk Estimates for Mancozeb - Foliar.								
Exposure Scenario	Crop or Target	Inhalation Unit Exposure ( $\mu\text{g}/\text{lb ai}$ ) <sup>1</sup>	Maximum Application Rate <sup>2</sup>	App Rate Unit	Area Treated or Amount Handled Daily <sup>3</sup>	Area Treated/Amount Handled Unit	Inhalation	
		Level of PPE or Engineering control					Dose ( $\text{mg}/\text{kg}/\text{day}$ ) <sup>4</sup>	MOE <sup>5</sup> (LOC = 10)
Wettable Powder, Chemigation, Broadcast	Field crop, high-acreage	2.75 [No-R]	1.6	lb ai/acre	350	acres	0.0193	990
Wettable Powder, Chemigation, Broadcast	Greenhouse (ornamentals, roses, cut flowers, container stock, vegetables)	2.75 [No-R]	1.6	lb ai/acre	60	acres	0.0033	5800
Wettable Powder, Chemigation, Broadcast	Nursery (ornamentals, vegetables, trees, container stock)	2.75 [No-R]	1.6	lb ai/acre	60	acres	0.0033	5800
Wettable Powder, Groundboom, Broadcast	Field-grown ornamental crops	2.75 [No-R]	1.6	lb ai/acre	40	acres	0.0022	8700
Wettable Powder, Groundboom, Broadcast	Nursery (ornamentals, vegetables, trees, container stock)	2.75 [No-R]	1.6	lb ai/acre	60	acres	0.0033	5800
Wettable Powder, Groundboom, Broadcast	Greenhouse (ornamentals, roses, cut flowers, container stock, vegetables)	2.75 [No-R]	1.6	lb ai/acre	60	acres	0.0033	5800
Wettable Powder, Groundboom, Broadcast	Orchard/Vineyard	2.75 [No-R]	4.8	lb ai/acre	40	acres	0.0066	2900
Wettable Powder, Groundboom, Broadcast	Field crop, typical	2.75 [No-R]	4.8	lb ai/acre	80	acres	0.0133	1400
Wettable Powder, Groundboom, Broadcast	Field crop, high-acreage	2.75 [No-R]	1.6	lb ai/acre	200	acres	0.011	1700
Wettable Powder, Dip Treatment,	Orchard/Vineyard	2.75 [No-R]	0.008	lb ai/gallon	1000	gallons solution	0.0066	2900
Wettable Powder, Dip Treatment,	Field crop, typical	2.75 [No-R]	0.03	lb ai/acre	1000	gallons solution	0.0133	1400
Wettable Powder, Dip Treatment,	Field crop, high-acreage	2.75 [No-R]	0.02	lb ai/acre	1000	gallons solution	0.011	1700
Water-soluble Packet, Airblast, Broadcast	Nursery (ornamentals, vegetables, trees, container stock)	2.6 [EC]	1.44	lb ai/acre	20	acres	0.000936	20000
Water-soluble Packet, Groundboom, Broadcast	Golf course (fairways, tees, greens)	2.6 [EC]	10.45	lb ai/acre	40	acres	0.0136	1400
Water-soluble Packet, Groundboom, Broadcast	Field-grown ornamental crops	2.6 [EC]	1.44	lb ai/acre	40	acres	0.00188	10000
Water-soluble Packet, Groundboom, Broadcast	Nursery (ornamentals, vegetables, trees, container stock)	2.6 [EC]	2.05	lb ai/acre	60	acres	0.004	4800
Water-soluble Packet, Groundboom, Broadcast	Greenhouse (ornamentals, roses, cut flowers, container stock, vegetables)	2.6 [EC]	2.05	lb ai/acre	60	acres	0.004	4800
<b>Applicator</b>								
Spray (all starting formulations), Aerial, Broadcast	Nursery (ornamentals, vegetables, trees, container stock)	0.0049 [EC]	1.2	lb ai/acre	60	acres	0.0000441	4300000

Table F-1. Occupational Handler Non-Cancer Exposure and Risk Estimates for Mancozeb - Foliar.								
Exposure Scenario	Crop or Target	Inhalation Unit Exposure ( $\mu\text{g}/\text{lb ai}$ ) <sup>1</sup>	Maximum Application Rate <sup>2</sup>	App Rate Unit	Area Treated or Amount Handled Daily <sup>3</sup>	Area Treated/Amount Handled Unit	Inhalation	
		Level of PPE or Engineering control					Dose ( $\text{mg}/\text{kg}/\text{day}$ ) <sup>4</sup>	MOE <sup>5</sup> (LOC = 10)
Spray (all starting formulations), Aerial, Broadcast	Orchard/Vineyard	0.0049 [EC]	6.38	lb ai/acre	350	acres	0.000136	140000
Spray (all starting formulations), Aerial, Broadcast	Sod	0.0049 [EC]	17.4	lb ai/acre	350	acres	0.000373	51000
Spray (all starting formulations), Aerial, Broadcast	Field crop, typical	0.0049 [EC]	4.8	lb ai/acre	350	acres	0.000103	190000
Spray (all starting formulations), Aerial, Broadcast	Field crop, high-acreage	0.0049 [EC]	1.6	lb ai/acre	1200	acres	0.000118	160000
Spray (all starting formulations), Airblast, Broadcast	Nursery (ornamentals, vegetables, trees, container stock)	4.71 [No-R]	2.25	lb ai/acre	20	acres	0.00265	7200
Spray (all starting formulations), Airblast, Broadcast	Orchard/Vineyard	4.71 [No-R]	6.38	lb ai/acre	40	acres	0.015	1300
Spray (all starting formulations), Groundboom, Broadcast	Golf course (fairways, tees, greens)	0.34 [No-R]	17.4	lb ai/acre	40	acres	0.00296	6500
Spray (all starting formulations), Groundboom, Broadcast	Field-grown ornamental crops	0.34 [No-R]	1.6	lb ai/acre	40	acres	0.000273	70000
Spray (all starting formulations), Groundboom, Broadcast	Nursery (ornamentals, vegetables, trees, container stock)	0.34 [No-R]	2.25	lb ai/acre	60	acres	0.000574	33000
Spray (all starting formulations), Groundboom, Broadcast	Greenhouse (ornamentals, roses, cut flowers, container stock, vegetables)	0.34 [No-R]	2.25	lb ai/acre	60	acres	0.000574	33000
Spray (all starting formulations), Groundboom, Broadcast	Sod	0.34 [No-R]	17.4	lb ai/acre	80	acres	0.00591	3200
Spray (all starting formulations), Groundboom, Broadcast	Orchard/Vineyard	0.34 [No-R]	6.38	lb ai/acre	40	acres	0.00109	18000
Spray (all starting formulations), Groundboom, Broadcast	Field crop, typical	0.34 [No-R]	4.8	lb ai/acre	80	acres	0.00164	12000

Table F-1. Occupational Handler Non-Cancer Exposure and Risk Estimates for Mancozeb - Foliar.								
Exposure Scenario	Crop or Target	Inhalation Unit Exposure ( $\mu\text{g}/\text{lb ai}$ ) <sup>1</sup>	Maximum Application Rate <sup>2</sup>	App Rate Unit	Area Treated or Amount Handled Daily <sup>3</sup>	Area Treated/Amount Handled Unit	Inhalation	
		Level of PPE or Engineering control					Dose ( $\text{mg}/\text{kg}/\text{day}$ ) <sup>4</sup>	MOE <sup>5</sup> (LOC = 10)
Spray (all starting formulations), Groundboom, Broadcast	Field crop, high-acreage	0.34 [No-R]	1.6	lb ai/acre	200	acres	0.00136	14000
<b>Flagger</b>								
Spray (all starting formulations), Aerial, Broadcast	Nursery (ornamentals, vegetables, trees, container stock)	0.202 [No-R]	2.25	lb ai/acre	60	acres	0.000341	56000
Spray (all starting formulations), Aerial, Broadcast	Orchard/Vineyard	0.202 [No-R]	6.38	lb ai/acre	350	acres	0.00564	3400
Spray (all starting formulations), Aerial, Broadcast	Sod	0.202 [No-R]	17.4	lb ai/acre	350	acres	0.0154	1200
Spray (all starting formulations), Aerial, Broadcast	Field crop, typical	0.202 [No-R]	4.8	lb ai/acre	350	acres	0.00424	4500
Spray (all starting formulations), Aerial, Broadcast	Field crop, high-acreage	0.202 [No-R]	1.6	lb ai/acre	350	acres	0.00141	14000
<b>Mixer/Loader/Applicator</b>								
Dry Flowable, Backpack, Broadcast	Greenhouse (ornamentals, roses, cut flowers, container stock, vegetables)	140 [No-R]	0.011	lb ai/gallon solution	7	gallons solution	0.000135	140000
Dry Flowable, Backpack, Broadcast (foliar)	Nursery (ornamentals, vegetables, trees, container stock)	69.1 [No-R]	0.011	lb ai/gallon solution	15	gallons solution	0.000143	130000
Dry Flowable, Manually-pressurized Handwand, Broadcast	Greenhouse (ornamentals, roses, cut flowers, container stock, vegetables)	23.6 [No-R]	0.011	lb ai/gallon solution	7	gallons solution	0.0000228	840000
Dry Flowable, Manually-pressurized Handwand, Broadcast (foliar)	Nursery (ornamentals, vegetables, trees, container stock)	23.6 [No-R]	0.011	lb ai/gallon solution	15	gallons solution	0.0000486	390000
Dry Flowable, Mechanically-pressurized Handgun, Broadcast (foliar)	Orchard/Vineyard	8.68 [No-R]	0.0638	lb ai/gallon solution	1000	gallons solution	0.00693	2800
Dry Flowable, Mechanically-pressurized Handgun, Broadcast	Greenhouse (ornamentals, roses, cut flowers, container stock, vegetables)	448 [No-R]	0.011	lb ai/gallon solution	175	gallons solution	0.0108	1800
Dry Flowable, Mechanically-pressurized Handgun, Broadcast	Golf course (fairways, tees, greens)	42 [No-R]	0.4	lb ai/acre	5	acres	0.00105	18000
Dry Flowable, Mechanically-pressurized Handgun, Broadcast (foliar)	Nursery (ornamentals, vegetables, trees, container stock)	448 [No-R]	0.011	lb ai/gallon solution	300	gallons solution	0.0185	1000

Table F-1. Occupational Handler Non-Cancer Exposure and Risk Estimates for Mancozeb - Foliar.								
Exposure Scenario	Crop or Target	Inhalation Unit Exposure ( $\mu\text{g}/\text{lb ai}$ ) <sup>1</sup>	Maximum Application Rate <sup>2</sup>	App Rate Unit	Area Treated or Amount Handled Daily <sup>3</sup>	Area Treated/Amount Handled Unit	Inhalation	
		Level of PPE or Engineering control					Dose ( $\text{mg}/\text{kg}/\text{day}$ ) <sup>4</sup>	MOE <sup>5</sup> (LOC = 10)
Dry Flowable, Mechanically-pressurized Handgun, Broadcast (foliar)	Field crop, typical	8.68 [No-R]	0.48	lb ai/gallon solution	1000	gallons solution	0.0521	370
Liquid, Backpack, Broadcast	Greenhouse (ornamentals, roses, cut flowers, container stock, vegetables)	140 [No-R]	0.012	lb ai/gallon solution	7	gallons solution	0.000148	130000
Liquid, Backpack, Broadcast (foliar)	Nursery (ornamentals, vegetables, trees, container stock)	69.1 [No-R]	0.012	lb ai/gallon solution	15	gallons solution	0.000155	120000
Liquid, Manually-pressurized Handwand, Broadcast	Greenhouse (ornamentals, roses, cut flowers, container stock, vegetables)	23.6 [No-R]	0.012	lb ai/gallon solution	7	gallons solution	0.0000248	770000
Liquid, Manually-pressurized Handwand, Broadcast (foliar)	Nursery (ornamentals, vegetables, trees, container stock)	23.6 [No-R]	0.012	lb ai/gallon solution	15	gallons solution	0.0000531	360000
Liquid, Mechanically-pressurized Handgun, Broadcast (foliar)	Orchard/Vineyard	8.68 [No-R]	0.48	lb ai/gallon solution	1000	gallons solution	0.0521	370
Liquid, Mechanically-pressurized Handgun, Broadcast	Greenhouse (ornamentals, roses, cut flowers, container stock, vegetables)	448 [No-R]	0.012	lb ai/gallon solution	175	gallons solution	0.0118	1600
Liquid, Mechanically-pressurized Handgun, Broadcast	Golf course (fairways, tees, greens)	1.9 [No-R]	17.4	lb ai/acre	5	acres	0.00206	9300
Liquid, Mechanically-pressurized Handgun, Broadcast (foliar)	Nursery (ornamentals, vegetables, trees, container stock)	448 [No-R]	0.012	lb ai/gallon solution	300	gallons solution	0.0201	950
Liquid, Mechanically-pressurized Handgun, Broadcast (foliar)	Field crop, typical	8.68 [No-R]	0.48	lb ai/gallon solution	1000	gallons solution	0.0521	370
Wettable Powder, Backpack, Broadcast	Greenhouse (ornamentals, roses, cut flowers, container stock, vegetables)	140 [No-R]	0.016	lb ai/gallon solution	7	gallons solution	0.000196	97000
Wettable Powder, Backpack, Broadcast (foliar)	Nursery (ornamentals, vegetables, trees, container stock)	69.1 [No-R]	0.016	lb ai/gallon solution	15	gallons solution	0.000208	92000
Wettable Powder, Manually-pressurized Handwand, Broadcast	Greenhouse (ornamentals, roses, cut flowers, container stock, vegetables)	23.6 [No-R]	0.016	lb ai/gallon solution	7	gallons solution	0.000033	580000
Wettable Powder, Manually-pressurized Handwand, Broadcast (foliar)	Nursery (ornamentals, vegetables, trees, container stock)	23.6 [No-R]	0.016	lb ai/gallon solution	15	gallons solution	0.0000708	270000
Wettable Powder, Mechanically-pressurized Handgun, Broadcast (foliar)	Orchard/Vineyard	8.68 [No-R]	0.096	lb ai/gallon solution	1000	gallons solution	0.0104	1800
Wettable Powder, Mechanically-pressurized Handgun, Broadcast	Greenhouse (ornamentals, roses, cut flowers, container stock, vegetables)	448 [No-R]	0.016	lb ai/gallon solution	175	gallons solution	0.0156	1200
Wettable Powder, Mechanically-pressurized Handgun, Broadcast (foliar)	Nursery (ornamentals, vegetables, trees, container stock)	448 [No-R]	0.016	lb ai/gallon solution	300	gallons solution	0.0269	710

**Table F-1. Occupational Handler Non-Cancer Exposure and Risk Estimates for Mancozeb - Foliar.**

Exposure Scenario	Crop or Target	Inhalation Unit Exposure (µg/lb ai) <sup>1</sup>	Maximum Application Rate <sup>2</sup>	App Rate Unit	Area Treated or Amount Handled Daily <sup>3</sup>	Area Treated/Amount Handled Unit	Inhalation	
		Level of PPE or Engineering control					Dose (mg/kg/day) <sup>4</sup>	MOE <sup>5</sup> (LOC = 10)
Wettable Powder, Mechanically-pressurized Handgun, Broadcast (foliar)	Field crop, typical	8.68 [No-R]	0.48	lb ai/gallon solution	1000	gallons solution	0.0521	370
Water-soluble Packet, Backpack, Broadcast	Greenhouse (ornamentals, roses, cut flowers, container stock, vegetables)	140 [No-R]	0.021	lb ai/gallon solution	7	gallons solution	0.000258	74000
Water-soluble Packet, Backpack, Broadcast (foliar)	Nursery (ornamentals, vegetables, trees, container stock)	69.1 [No-R]	0.021	lb ai/gallon solution	15	gallons solution	0.000273	70000
Water-soluble Packet, Manually-pressurized Handwand, Broadcast	Greenhouse (ornamentals, roses, cut flowers, container stock, vegetables)	23.6 [No-R]	0.021	lb ai/gallon solution	7	gallons solution	0.0000434	440000
Water-soluble Packet, Manually-pressurized Handwand, Broadcast (foliar)	Nursery (ornamentals, vegetables, trees, container stock)	23.6 [No-R]	0.021	lb ai/gallon solution	15	gallons solution	0.0000929	210000
Water-soluble Packet, Mechanically-pressurized Handgun, Broadcast	Greenhouse (ornamentals, roses, cut flowers, container stock, vegetables)	448 [No-R]	0.021	lb ai/gallon solution	175	gallons solution	0.0206	930
Water-soluble Packet, Mechanically-pressurized Handgun, Broadcast	Golf course (fairways, tees, greens)	18 [No-R]	0.048	lb ai/acre	5	acres	0.000054	350000
Water-soluble Packet, Mechanically-pressurized Handgun, Broadcast (foliar)	Nursery (ornamentals, vegetables, trees, container stock)	448 [No-R]	0.021	lb ai/gallon solution	300	gallons solution	0.0353	540

- 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 PPE: No-R, EC = no-respirator, engineering controls.
- 2 Based on registered labels (see Appendix D).
- 3 Exposure Science Advisory Council Policy #9.1.
- 4 Inhalation Dose = Inhalation Unit Exposure (µg/lb ai) × Conversion Factor (0.001 mg/µg) × Application Rate (lb ai/acre or gal) × Area Treated or Amount Handled (A or gal/day) ÷ BW (80 kg).
- 5 Inhalation MOE = Inhalation POD (19.1 mg/kg/day) ÷ Inhalation Dose (mg/kg/day).

**Table F-2. Occupational Handler Non-Cancer Exposure and Risk Estimates for Mancozeb – Seed Treatment.**

Crop/Target Category	Specialized Treatment or Formulation	Activity	Application Rate (lb ai/lb seed) <sup>1</sup>	Exposure Variable <sup>2</sup>	Inhalation Dose <sup>3</sup> (mg/kg-day) [No-R, unless otherwise noted]	Inhalation MOE <sup>4</sup> [No-R, unless otherwise noted] (LOC = 10)	
<b>Commercial Seed Treatment</b>							
Barley	NA	Treating	0.0315	360,000 (AST)	0.51	110	
		Packaging			0.105	37	
		Cleaning			2.5 hours (AD)	0.509	180
		Loading/Planting			184,240,000 (NSP)	0.206	38
Corn, field	NA	Treating	0.0405	339,500 (AST)	0.619	93	
		Packaging			0.134	31	
		Cleaning			2.5 hours (AD)	0.198	140

Table F-2. Occupational Handler Non-Cancer Exposure and Risk Estimates for Mancozeb – Seed Treatment.						
Crop/Target Category	Specialized Treatment or Formulation	Activity	Application Rate (lb ai/lb seed) <sup>1</sup>	Exposure Variable <sup>2</sup>	Inhalation Dose <sup>3</sup> (mg/kg-day) [No-R, unless otherwise noted]	Inhalation MOE <sup>4</sup> [No-R, unless otherwise noted] (LOC = 10)
Cotton	NA	Loading/Planting	0.045	8,050,000 (NSP)	0.0844	96
		Treating		125,000 (AST)	0.254	230
		Packaging		2.5 hours (AD)	0.149	75
		Cleaning		17,000,000 (NSP)	0.14	130
		Loading/Planting		0.1	140	
Flax	NA	Treating	0.0533	125,000 (AST)	0.3	190
		Packaging		2.5 hours (AD)	0.176	64
		Cleaning		243,936,000 (NSP)	0.176	110
		Loading/Planting		0.255	110	
Oat	NA	Treating	0.0473	360,000 (AST)	0.766	75
		Packaging		2.5 hours (AD)	0.156	25
		Cleaning		234,000,000 (NSP)	0.703	120
		Loading/Planting		0.226	27	
Peanut	NA	Treating	0.12	126,000 (AST)	0.68	85
		Packaging		2.5 hours (AD)	0.398	28
		Cleaning		8,400,000 (NSP)	1.81	48
		Loading/Planting		0.0096	11	
Potato	NA	Treating	0.0008	800,000 (AST)	0.0288	2000
		Packaging		2.5 hours (AD)	0.00265	660
		Cleaning		2,125,728 (NSP)	0.28	7200
		Loading/Planting		0.145	68	
Rice	NA	Treating	0.032	302,500 (AST)	0.435	130
		Packaging		2.5 hours (AD)	0.106	44
		Cleaning		487,672,000 (NSP)	0.825	180
		Loading/Planting		0.146	23	
Rye	NA	Treating	0.027	360,000 (AST)	0.438	130
		Packaging		2.5 hours (AD)	0.0895	44
		Cleaning		324,000,000 (NSP)	0.401	210
		Loading/Planting		0.081	48	
Safflower	NA	Treating	0.015	360,000 (AST)	0.243	240
		Packaging		2.5 hours (AD)	0.0498	79
		Cleaning		38,102,400 (NSP)	0.0346	380
		Loading/Planting		0.183	550	
Sorghum, grain	NA	Treating	0.0338	360,000 (AST)	0.548	100
		Packaging		2.5 hours (AD)	0.112	35
		Cleaning		8,000,000 (NSP)	0.0268	170
		Loading/Planting		0.0027	710	
Tomato	Film-coated	Treating	0.06	3,000 (AST)	0.0081	7100
	Film-coated	Packaging		2.5 hours (AD)	0.199	2400
	Film-coated	Cleaning		10.454,400 (NSP)	0.00431	96
	Film-coated	Loading/Planting		0.000203	4400	
	Encrusted/Pelleted	Treating		225 (AST)	0.000608	94000
	Encrusted/Pelleted	Packaging		0.199	31000	

Table F-2. Occupational Handler Non-Cancer Exposure and Risk Estimates for Mancozeb – Seed Treatment.							
Crop/Target Category	Specialized Treatment or Formulation	Activity	Application Rate (lb ai/lb seed) <sup>1</sup>	Exposure Variable <sup>2</sup>	Inhalation Dose <sup>3</sup> (mg/kg-day) [No-R, unless otherwise noted]	Inhalation MOE <sup>4</sup> [No-R, unless otherwise noted] (LOC = 10)	
	Encrusted/Pelleted	Cleaning		2.5 hours (AD)	0.00431	96	
	Encrusted/Pelleted	Loading/Planting		10.454.400 (NSP)	0.134	4400	
Triticale	NA	Treating	0.0248	360,000 (AST)	0.401	140	
		Packaging			0.0823	48	
		Cleaning			2.5 hours (AD)	0.446	230
		Loading/Planting			327,000,000 (NSP)	0.134	43
Wheat	NA	Treating	0.0248	360,000 (AST)	0.401	140	
		Packaging			0.0823	48	
		Cleaning			2.5 hours (AD)	0.643	230
		Loading/Planting			300,000,000 (NSP)	0.51	30
On-Farm Seed Treatment							
Barley	Liquid	Treating & Planting	0.00209	184,240,000 (NSP)	0.019	1000	
	Dust/Powder [Solids]		0.00131		0.204	94	
Corn, field	Liquid		0.00209	8,050,000 (NSP)	0.00574	3300	
Cotton	Liquid		0.003	17,000,000 (NSP)	0.00525	3600	
Flax	Liquid		0.003	243,936,000 (NSP)	0.00556	3400	
Oat	Liquid		0.00313	234,000,000 (NSP)	0.0261	730	
	Dust/Powder [Solids]		0.00197		0.28	68	
Peanut	Liquid		0.008	8,400,000 (NSP)	0.0678	280	
Potato	Liquid		0.000781	2,125,728 (NSP)	0.154	120	
	Dust/Powder [Solids]		0.0008		2.69	7.1	
						0.269 [PF10-R]	71 [PF10-R]
Rice	Liquid		0.002	487,672,000 (NSP)	0.029	660	
	Dust/Powder [Solids]		0.00125		0.309	62	
Rye	Liquid		0.00178	324,000,000 (NSP)	0.0149	1300	
	Dust/Powder [Solids]		0.00113		0.161	120	
Safflower	Liquid		0.001	38,102,400 (NSP)	0.0013	15000	
	Dust/Powder [Solids]		0.00094		0.0209	910	
Sorghum, grain	Liquid		0.00225	8,000,000 (NSP)	0.001	19000	
	Dust/Powder [Solids]		0.00094		0.00714	2700	
Tomato	Liquid		0.004	10,454,400 (NSP)	0.00714	2700	
Triticale	Liquid	0.00163	327,000,000 (NSP)	0.000161	120000		
	Dust/Powder [Solids]	0.00103		0.0165	1200		
Wheat	Liquid	0.00163	300,000,000 (NSP)	0.178	110		
	Dust/Powder [Solids]	0.00103		0.0238	800		

\*PPE: No-R = No Respirator. PF10-R = Protection Factor 10 Respirator.

<sup>1</sup> Seed Treatment Application rates based on the registered mancozeb labels. See Appendix E.

<sup>2</sup> HED default for lb seed treated/planted per day from HED Exposure Science Advisory Council Policy 15.2 (January 2022). Exposure Variables: Cleaning, Activity Duration (AD, hrs); Packaging and Treating, Amount Seed Treated (AST, lb seed); Loading/Planting, Number of Seeds Planted (NSP, number of seeds).

<sup>3</sup> Commercial Seed Treaters and Packagers: Inhalation Dose = Inhalation Unit Exposure (µg/lb ai) × Conversion Factor (0.001 mg/µg) × Application Rate (lb ai/lb seed) × Amount of Seed Treated (lb seed/day) ÷ BW (80 kg).

Commercial Seed Treatment Cleaners: Inhalation Dose = Inhalation Unit Exposure (µg/lb ai) × Conversion Factor (0.001 mg/µg) × Application Rate (lb ai/lb seed) × Activity Duration (2.5 hr) ÷ BW (80 kg).

*Commercial Seed Treatment Loading/Planting:* Inhalation Dose (mg/kg/day) = Inhalation Unit Exposure (mg/day) × Conversion Factor (0.001 mg/μg) × Application Rate (lb ai/seed) × Number of Seeds Planted (NSP) ÷ BW (80 kg).

*On-Farm Treaters/Planters:* Inhalation Dose = Inhalation Unit Exposure (μg/lb ai) × Conversion Factor (0.001 mg/μg) × Application Rate (lb ai/lb seed) × Number of Seeds Planted (NSP) ÷ BW (80 kg).

<sup>4</sup> Inhalation MOE = Inhalation POD (19.1 mg/kg/day) ÷ Total Inhalation Dose (mg/kg/day).

Table F-3. Occupational Handler Non-Cancer Exposure and Risk Estimates for ETU - Foliar.												
Exposure Scenario	Crop or Target	Dermal Unit Exposure (μg/lb ai) <sup>1</sup>	Level of PPE or Engineering control	Inhalation Unit Exposure (μg/lb ai) <sup>1</sup>	Level of PPE or Engineering control <sup>1</sup>	Maximum Application Rate (lb ai/A) <sup>2</sup>	Area Treated or Amount Handled Daily (acres) <sup>3</sup>	Dermal		Inhalation		Total
								Total Dose (mg/kg/day) <sup>4</sup>	MOE <sup>5</sup>	Total Dose <sup>6</sup> (mg/kg/day)	MOE <sup>7</sup>	MOE <sup>8</sup>
<b>Mixer/Loader</b>												
Dry Flowable, Aerial, Broadcast	Nursery (ornamentals, vegetables, trees, container stock)	51.6	SL/G	0.896	PF10 R	2.25	60	0.000706	2800	0.000115	1700	1100
Dry Flowable, Aerial, Broadcast	Orchard/Vineyard	12.5	EC/G	0.26	EC/PF10 R	4.8	350	0.000213	940	0.000415	480	320
Dry Flowable, Aerial, Broadcast	Sod	12.5	EC/G	0.26	EC/PF10 R	17.4	350	0.000771	260	0.0015	130	87
Dry Flowable, Aerial, Broadcast	Field crop, typical	12.5	EC/G	0.26	EC/PF10 R	4.5	350	0.000199	1000	0.00039	510	340
Dry Flowable, Aerial, Broadcast	Field crop, high-acreage	12.5	EC/G	0.26	EC/PF10 R	1.5	1200	0.000228	880	0.000445	450	300
Dry Flowable, Airblast, Broadcast	Nursery (ornamentals, vegetables, trees, container stock)	51.6	SL/G	8.96	No-R	2.25	20	0.000235	8500	0.000383	520	490
Dry Flowable, Airblast, Broadcast	Orchard/Vineyard	51.6	SL/G	0.896	PF10 R	4.8	40	0.0001	2000	0.000163	1200	750
Dry Flowable, Chemigation, Broadcast	Orchard/Vineyard	12.5	EC/G	0.26	EC/PF10 R	4.8	350	0.000213	940	0.000415	480	320
Dry Flowable, Chemigation, Broadcast	Field crop, typical	12.5	EC/G	0.26	EC/PF10 R	4.5	350	0.000199	1000	0.00039	510	340
Dry Flowable, Chemigation, Broadcast	Field crop, high-acreage	41.2	DL/G	0.896	PF10 R	1.5	350	0.000219	910	0.000447	450	300
Dry Flowable, Chemigation, Broadcast	Greenhouse (ornamentals, roses, cut flowers, container stock, vegetables)	51.6	SL/G	0.896	PF10 R	2.25	60	0.000706	2800	0.000115	1700	1100

Table F-3. Occupational Handler Non-Cancer Exposure and Risk Estimates for ETU - Foliar.												
Exposure Scenario	Crop or Target	Dermal Unit Exposure ( $\mu\text{g}/\text{lb ai}$ ) <sup>1</sup>	Level of PPE or Engineering control	Inhalation Unit Exposure ( $\mu\text{g}/\text{lb ai}$ ) <sup>1</sup>	Level of PPE or Engineering control <sup>1</sup>	Maximum Application Rate ( $\text{lb ai}/\text{A}$ ) <sup>2</sup>	Area Treated or Amount Handled Daily (acres) <sup>3</sup>	Dermal		Inhalation		Total
								Total Dose ( $\text{mg}/\text{kg}/\text{day}$ ) <sup>4</sup>	MOE <sup>5</sup>	Total Dose <sup>6</sup> ( $\text{mg}/\text{kg}/\text{day}$ )	MOE <sup>7</sup>	MOE <sup>8</sup>
Dry Flowable, Chemigation, Broadcast	Nursery (ornamentals, vegetables, trees, container stock)	51.6	SL/G	0.896	PF10 R	2.25	60	0.0000706	2800	0.000115	1700	1100
Dry Flowable, Groundboom, Broadcast	Golf course (fairways, tees, greens)	12.5	EC/G	0.26	EC/PF10 R	17.4	40	0.0000881	2300	0.000172	1200	790
Dry Flowable, Groundboom, Broadcast	Field-grown ornamental crops	51.6	SL/G	8.96	No-R	1.5	40	0.0000314	6400	0.000511	390	370
Dry Flowable, Groundboom, Broadcast	Nursery (ornamentals, vegetables, trees, container stock)	51.6	SL/G	0.896	PF10 R	2.25	60	0.0000706	2800	0.000115	1700	1100
Dry Flowable, Groundboom, Broadcast	Greenhouse (ornamentals, roses, cut flowers, container stock, vegetables)	51.6	SL/G	0.896	PF10 R	2.25	60	0.0000706	2800	0.000115	1700	1100
Dry Flowable, Groundboom, Broadcast	Sod	12.5	EC/G	0.26	EC/PF10 R	17.4	80	0.000176	1100	0.000344	580	380
Dry Flowable, Groundboom, Broadcast	Orchard/Vineyard	51.6	SL/G	0.896	PF10 R	4.8	40	0.0001	2000	0.000163	1200	750
Dry Flowable, Groundboom, Broadcast	Field crop, typical	51.6	SL/G	0.896	PF10 R	4.8	80	0.0002	1000	0.000327	610	380
Dry Flowable, Groundboom, Broadcast	Field crop, high-acreage	51.6	SL/G	0.896	PF10 R	1.5	200	0.000157	1300	0.000256	780	490
Dry Flowable, Dip Treatment, Broadcast (foliar)	Field crop, high-acreage	51.6	SL/G	8.68	No-R	0.008	1000 gallons solution	0.00000418	48000	0.0000659	3000	2800
Dry Flowable, Dip Treatment, Broadcast (foliar)	Field crop, typical	51.6	SL/G	8.68	No-R	0.02	1000 gallons solution	0.0000104	19000	0.000165	1200	1100
Dry Flowable, Dip Treatment, Broadcast (foliar)	Orchard/Vineyard	51.6	SL/G	8.68	No-R	0.03	1000 gallons solution	0.0000157	13000	0.000247	810	760

Table F-3. Occupational Handler Non-Cancer Exposure and Risk Estimates for ETU - Foliar.												
Exposure Scenario	Crop or Target	Dermal Unit Exposure ( $\mu\text{g}/\text{lb ai}$ ) <sup>1</sup>	Level of PPE or Engineering control	Inhalation Unit Exposure ( $\mu\text{g}/\text{lb ai}$ ) <sup>1</sup>	Level of PPE or Engineering control <sup>1</sup>	Maximum Application Rate ( $\text{lb ai}/\text{A}$ ) <sup>2</sup>	Area Treated or Amount Handled Daily (acres) <sup>3</sup>	Dermal		Inhalation		Total
								Total Dose ( $\text{mg}/\text{kg}/\text{day}$ ) <sup>4</sup>	MOE <sup>5</sup>	Total Dose <sup>6</sup> ( $\text{mg}/\text{kg}/\text{day}$ )	MOE <sup>7</sup>	MOE <sup>8</sup>
Liquid, Aerial, Broadcast	Nursery (ornamentals, vegetables, trees, container stock)	37.6	SL/G	0.219	No-R	1.2	60	0.0000274	7300	0.000015	13000	4700
Liquid, Aerial, Broadcast	Orchard/Vineyard	37.6	SL/G	0.0219	PF10 R	4.8	350	0.00064	310	0.000035	5700	290
Liquid, Aerial, Broadcast	Sod	4.02	EC/G	0.011	EC/No-R	17.4	350	0.000248	810	0.0000637	3100	640
Liquid, Aerial, Broadcast	Field crop, typical	37.6	SL/G	0.0219	PF10 R	4.8	350	0.00064	310	0.000035	5700	290
Liquid, Aerial, Broadcast	Field crop, high-acreage	29.1	DL/G	0.0219	PF10 R	1.6	1200	0.000566	350	0.0000399	5000	330
Liquid, Airblast, Broadcast	Nursery (ornamentals, vegetables, trees, container stock)	37.6	SL/G	0.219	No-R	1.2	20	0.00000913	22000	0.000005	40000	14000
Liquid, Airblast, Broadcast	Orchard/Vineyard	37.6	SL/G	0.219	No-R	4.8	40	0.0000731	2700	0.0000399	5000	1800
Liquid, Chemigation, Broadcast	Orchard/Vineyard	37.6	SL/G	0.0219	PF10 R	4.8	350	0.00064	310	0.000035	5700	290
Liquid, Chemigation, Broadcast	Sod	4.02	EC/G	0.011	EC/No-R	17.4	350	0.000248	810	0.0000637	3100	640
Liquid, Chemigation, Broadcast	Field crop, typical	37.6	SL/G	0.0219	PF10 R	4.8	350	0.00064	310	0.000035	5700	290
Liquid, Chemigation, Broadcast	Field crop, high-acreage	37.6	SL/G	0.219	No-R	1.6	350	0.000214	930	0.000117	1700	600
Liquid, Chemigation, Broadcast	Greenhouse (ornamentals, roses, cut flowers, container stock, vegetables)	37.6	SL/G	0.219	No-R	1.2	60	0.0000274	7300	0.000015	13000	4700
Liquid, Chemigation, Broadcast	Nursery (ornamentals, vegetables, trees, container stock)	37.6	SL/G	0.219	No-R	1.2	60	0.0000274	7300	0.000015	13000	4700
Liquid, Groundboom, Broadcast	Golf course (fairways, tees, greens)	37.6	SL/G	0.219	No-R	17.4	40	0.000265	750	0.000144	1400	490
Liquid, Groundboom, Broadcast	Field-grown ornamental crops	37.6	SL/G	0.219	No-R	1.2	40	0.0000182	11000	0.00000998	20000	7100

Table F-3. Occupational Handler Non-Cancer Exposure and Risk Estimates for ETU - Foliar.												
Exposure Scenario	Crop or Target	Dermal Unit Exposure ( $\mu\text{g}/\text{lb ai}$ ) <sup>1</sup>	Level of PPE or Engineering control	Inhalation Unit Exposure ( $\mu\text{g}/\text{lb ai}$ ) <sup>1</sup>	Level of PPE or Engineering control <sup>1</sup>	Maximum Application Rate ( $\text{lb ai}/\text{A}$ ) <sup>2</sup>	Area Treated or Amount Handled Daily (acres) <sup>3</sup>	Dermal		Inhalation		Total
								Total Dose ( $\text{mg}/\text{kg}/\text{day}$ ) <sup>4</sup>	MOE <sup>5</sup>	Total Dose <sup>6</sup> ( $\text{mg}/\text{kg}/\text{day}$ )	MOE <sup>7</sup>	MOE <sup>8</sup>
Liquid, Groundboom, Broadcast	Nursery (ornamentals, vegetables, trees, container stock)	37.6	SL/G	0.219	No-R	1.2	60	0.0000274	7300	0.000015	13000	4700
Liquid, Groundboom, Broadcast	Greenhouse (ornamentals, roses, cut flowers, container stock, vegetables)	37.6	SL/G	0.219	No-R	1.2	60	0.0000274	7300	0.000015	13000	4700
Liquid, Groundboom, Broadcast	Sod	37.6	SL/G	0.0219	PF10 R	17.4	80	0.00053	380	0.000029	6900	360
Liquid, Groundboom, Broadcast	Orchard/Vineyard	37.6	SL/G	0.219	No-R	4.8	40	0.0000731	2700	0.0000399	5000	1800
Liquid, Groundboom, Broadcast	Field crop, typical	37.6	SL/G	0.219	No-R	4.8	80	0.000146	1400	0.0000799	2500	900
Liquid, Groundboom, Broadcast	Field crop, high-acreage	37.6	SL/G	0.219	No-R	1.6	200	0.000122	1600	0.0000666	3000	1000
Liquid, Dip Treatment, Broadcast (foliar)	Field crop, high-acreage	51.6	SL/G	8.68	No-R	0.008	1000 gallons solution	0.00000418	48000	0.0000659	3000	2800
Liquid, Dip Treatment, Broadcast (foliar)	Field crop, typical	51.6	SL/G	8.68	No-R	0.02	1000 gallons solution	0.0000104	19000	0.000165	1200	1100
Liquid, Dip Treatment, Broadcast (foliar)	Orchard/Vineyard	51.6	SL/G	8.68	No-R	0.03	1000 gallons solution	0.0000157	13000	0.000247	810	760
Wettable Powder, Aerial, Broadcast	Nursery (ornamentals, vegetables, trees, container stock)	57.5	SL/G	2.75	No-R	1.6	60	0.0000559	3600	0.000251	800	650
Wettable Powder, Aerial, Broadcast	Orchard/Vineyard	12.5	EC/G	0.26	EC/PF10 R	4.8	350	0.000213	940	0.000415	480	320
Wettable Powder, Aerial, Broadcast	Field crop, typical	12.5	EC/G	0.26	EC/PF10 R	4.8	350	0.000213	940	0.000415	480	320
Wettable Powder, Aerial, Broadcast	Field crop, high-acreage	12.5	EC/G	0.26	EC/PF10 R	1.6	1200	0.000243	820	0.000474	420	280
Wettable Powder, Airblast, Broadcast	Nursery (ornamentals, vegetables, trees, container stock)	57.5	SL/G	2.75	No-R	1.6	20	0.0000186	11000	0.0000836	2400	2000

Table F-3. Occupational Handler Non-Cancer Exposure and Risk Estimates for ETU - Foliar.												
Exposure Scenario	Crop or Target	Dermal Unit Exposure ( $\mu\text{g}/\text{lb ai}$ ) <sup>1</sup>	Level of PPE or Engineering control	Inhalation Unit Exposure ( $\mu\text{g}/\text{lb ai}$ ) <sup>1</sup>	Level of PPE or Engineering control <sup>1</sup>	Maximum Application Rate ( $\text{lb ai}/\text{A}$ ) <sup>2</sup>	Area Treated or Amount Handled Daily ( $\text{acres}$ ) <sup>3</sup>	Dermal		Inhalation		Total
								Total Dose ( $\text{mg}/\text{kg}/\text{day}$ ) <sup>4</sup>	MOE <sup>5</sup>	Total Dose <sup>6</sup> ( $\text{mg}/\text{kg}/\text{day}$ )	MOE <sup>7</sup>	MOE <sup>8</sup>
Wettable Powder, Airblast, Broadcast	Orchard/Vineyard	57.5	SL/G	2.75	No-R	4.8	40	0.000111	1800	0.000502	400	330
Wettable Powder, Chemigation, Broadcast	Orchard/Vineyard	12.5	EC/G	0.26	EC/PF10 R	4.8	350	0.000213	940	0.000415	480	320
Wettable Powder, Chemigation, Broadcast	Field crop, typical	12.5	EC/G	0.26	EC/PF10 R	4.8	350	0.000213	940	0.000415	480	320
Wettable Powder, Chemigation, Broadcast	Field crop, high-acreage	57.5	SL/G	0.275	PF10 R	1.6	350	0.000326	610	0.000146	1400	420
Wettable Powder, Chemigation, Broadcast	Greenhouse (ornamentals, roses, cut flowers, container stock, vegetables)	57.5	SL/G	2.75	No-R	1.6	60	0.0000559	3600	0.000251	800	650
Wettable Powder, Chemigation, Broadcast	Nursery (ornamentals, vegetables, trees, container stock)	57.5	SL/G	2.75	No-R	1.6	60	0.0000559	3600	0.000251	800	650
Wettable Powder, Groundboom, Broadcast	Field-grown ornamental crops	57.5	SL/G	2.75	No-R	1.6	40	0.0000373	5400	0.000167	1200	980
Wettable Powder, Groundboom, Broadcast	Nursery (ornamentals, vegetables, trees, container stock)	57.5	SL/G	2.75	No-R	1.6	60	0.0000559	3600	0.000251	800	650
Wettable Powder, Groundboom, Broadcast	Greenhouse (ornamentals, roses, cut flowers, container stock, vegetables)	57.5	SL/G	2.75	No-R	1.6	60	0.0000559	3600	0.000251	800	650
Wettable Powder, Groundboom, Broadcast	Orchard/Vineyard	57.5	SL/G	2.75	No-R	4.8	40	0.000111	1800	0.000502	400	330
Wettable Powder, Groundboom, Broadcast	Field crop, typical	57.5	SL/G	0.275	PF10 R	4.8	80	0.000224	890	0.000101	2000	620
Wettable Powder, Groundboom, Broadcast	Field crop, high-acreage	57.5	SL/G	0.275	PF10 R	1.6	200	0.000186	1100	0.0000836	2400	750

Table F-3. Occupational Handler Non-Cancer Exposure and Risk Estimates for ETU - Foliar.												
Exposure Scenario	Crop or Target	Dermal Unit Exposure ( $\mu\text{g}/\text{lb ai}$ ) <sup>1</sup>	Level of PPE or Engineering control	Inhalation Unit Exposure ( $\mu\text{g}/\text{lb ai}$ ) <sup>1</sup>	Level of PPE or Engineering control <sup>1</sup>	Maximum Application Rate ( $\text{lb ai}/\text{A}$ ) <sup>2</sup>	Area Treated or Amount Handled Daily (acres) <sup>3</sup>	Dermal		Inhalation		Total
								Total Dose ( $\text{mg}/\text{kg}/\text{day}$ ) <sup>4</sup>	MOE <sup>5</sup>	Total Dose <sup>6</sup> ( $\text{mg}/\text{kg}/\text{day}$ )	MOE <sup>7</sup>	MOE <sup>8</sup>
Wettable Powder, Dip Treatment, Broadcast (foliar)	Field crop, high-acreage	51.6	SL/G	8.68	No-R	0.008	1000 gallons solution	0.00000418	48000	0.0000659	3000	2800
Wettable Powder, Dip Treatment, Broadcast (foliar)	Field crop, typical	51.6	SL/G	8.68	No-R	0.02	1000 gallons solution	0.0000104	19000	0.000165	1200	1100
Wettable Powder, Dip Treatment, Broadcast (foliar)	Orchard/Vineyard	51.6	SL/G	8.68	No-R	0.03	1000 gallons solution	0.0000157	13000	0.000247	810	760
Water-soluble Packet, Airblast, Broadcast	Nursery (ornamentals, vegetables, trees, container stock)	12.5	EC/G	2.6	EC/No-R	1.44	20	0.00000365	55000	0.0000712	2800	2700
Water-soluble Packet, Groundboom, Broadcast	Golf course (fairways, tees, greens)	12.5	EC/G	0.26	EC/PF10 R	10.45	40	0.000053	3800	0.000104	1900	1300
Water-soluble Packet, Groundboom, Broadcast	Field-grown ornamental crops	12.5	EC/G	2.6	EC/No-R	1.44	40	0.00000729	27000	0.000143	1400	1300
Water-soluble Packet, Groundboom, Broadcast	Nursery (ornamentals, vegetables, trees, container stock)	12.5	EC/G	2.6	EC/No-R	2.05	60	0.0000156	13000	0.000304	660	630
Water-soluble Packet, Groundboom, Broadcast	Greenhouse (ornamentals, roses, cut flowers, container stock, vegetables)	12.5	EC/G	2.6	EC/No-R	2.05	60	0.0000156	13000	0.000304	660	630
Applicator												
Spray (all starting formulations), Aerial, Broadcast	Nursery (ornamentals, vegetables, trees, container stock)	2.08	EC/G	0.0049	EC/No-R	1.2	60	0.00000152	130000	0.000000335	600000	110000
Spray (all starting formulations), Aerial, Broadcast	Orchard/Vineyard	2.08	EC/G	0.0049	EC/No-R	4.8	350	0.0000353	5700	0.00000782	26000	4700

Table F-3. Occupational Handler Non-Cancer Exposure and Risk Estimates for ETU - Foliar.												
Exposure Scenario	Crop or Target	Dermal Unit Exposure ( $\mu\text{g}/\text{lb ai}$ ) <sup>1</sup>	Level of PPE or Engineering control	Inhalation Unit Exposure ( $\mu\text{g}/\text{lb ai}$ ) <sup>1</sup>	Level of PPE or Engineering control <sup>1</sup>	Maximum Application Rate ( $\text{lb ai}/\text{A}$ ) <sup>2</sup>	Area Treated or Amount Handled Daily (acres) <sup>3</sup>	Dermal		Inhalation		Total
								Total Dose ( $\text{mg}/\text{kg}/\text{day}$ ) <sup>4</sup>	MOE <sup>5</sup>	Total Dose <sup>6</sup> ( $\text{mg}/\text{kg}/\text{day}$ )	MOE <sup>7</sup>	MOE <sup>8</sup>
Spray (all starting formulations), Aerial, Broadcast	Sod	2.08	EC/G	0.0049	EC/No-R	17.4	350	0.000129	1600	0.0000283	7100	1300
Spray (all starting formulations), Aerial, Broadcast	Field crop, typical	2.08	EC/G	0.0049	EC/No-R	4.8	350	0.0000353	5700	0.00000782	26000	4700
Spray (all starting formulations), Aerial, Broadcast	Field crop, high-acreage	2.08	EC/G	0.0049	EC/No-R	1.6	1200	0.0000404	5000	0.00000894	22000	4100
Spray (all starting formulations), Airblast, Broadcast	Nursery (ornamentals, vegetables, trees, container stock)	14.6	EC/G	0.068	EC/No-R	2.25	20	0.00000665	30000	0.00000291	69000	21000
Spray (all starting formulations), Airblast, Broadcast	Orchard/Vineyard	14.6	EC/G	0.068	EC/No-R	4.8	40	0.0000284	7000	0.0000124	16000	4900
Spray (all starting formulations), Groundboom, Broadcast	Golf course (fairways, tees, greens)	16.1	SL/G	0.34	No-R	17.4	40	0.000113	1800	0.000225	890	600
Spray (all starting formulations), Groundboom, Broadcast	Field-grown ornamental crops	16.1	SL/G	0.34	No-R	1.6	40	0.0000104	19000	0.0000207	9700	6400
Spray (all starting formulations), Groundboom, Broadcast	Nursery (ornamentals, vegetables, trees, container stock)	16.1	SL/G	0.34	No-R	2.25	60	0.000022	9100	0.0000436	4600	3100
Spray (all starting formulations), Groundboom, Broadcast	Greenhouse (ornamentals, roses, cut flowers, container stock, vegetables)	16.1	SL/G	0.34	No-R	2.25	60	0.000022	9100	0.0000436	4600	3100

Table F-3. Occupational Handler Non-Cancer Exposure and Risk Estimates for ETU - Foliar.												
Exposure Scenario	Crop or Target	Dermal Unit Exposure ( $\mu\text{g}/\text{lb ai}$ ) <sup>1</sup>	Level of PPE or Engineering control	Inhalation Unit Exposure ( $\mu\text{g}/\text{lb ai}$ ) <sup>1</sup>	Level of PPE or Engineering control <sup>1</sup>	Maximum Application Rate ( $\text{lb ai}/\text{A}$ ) <sup>2</sup>	Area Treated or Amount Handled Daily (acres) <sup>3</sup>	Dermal		Inhalation		Total
								Total Dose ( $\text{mg}/\text{kg}/\text{day}$ ) <sup>4</sup>	MOE <sup>5</sup>	Total Dose <sup>6</sup> ( $\text{mg}/\text{kg}/\text{day}$ )	MOE <sup>7</sup>	MOE <sup>8</sup>
Spray (all starting formulations), Groundboom, Broadcast	Sod	16.1	SL/G	0.34	No-R	17.4	80	0.000227	880	0.000449	450	300
Spray (all starting formulations), Groundboom, Broadcast	Orchard/Vineyard	16.1	SL/G	0.34	No-R	4.8	40	0.0000313	6400	0.000062	3200	2100
Spray (all starting formulations), Groundboom, Broadcast	Field crop, typical	16.1	SL/G	0.34	No-R	4.8	80	0.0000626	3200	0.000124	1600	1100
Spray (all starting formulations), Groundboom, Broadcast	Field crop, high-acreage	16.1	SL/G	0.34	No-R	1.6	200	0.0000521	3800	0.000104	1900	1300
<b>Flagger</b>												
Spray (all starting formulations), Aerial, Broadcast	Nursery (ornamentals, vegetables, trees, container stock)	12	SL/G	0.202	No-R	2.25	60	0.000035	5700	0.0000553	3600	2200
Spray (all starting formulations), Aerial, Broadcast	Orchard/Vineyard	12	SL/G	0.202	No-R	4.8	350	0.000205	980	0.000322	620	380
Spray (all starting formulations), Aerial, Broadcast	Sod	10.6	DL/G	0.0202	PF10 R	17.4	350	0.000654	310	0.000117	1700	<b>260</b>
Spray (all starting formulations), Aerial, Broadcast	Field crop, typical	12	SL/G	0.202	No-R	4.8	350	0.000205	980	0.000322	620	380
Spray (all starting formulations), Aerial, Broadcast	Field crop, high-acreage	12	SL/G	0.202	No-R	1.6	350	0.000068	2900	0.000107	1900	1100

Table F-3. Occupational Handler Non-Cancer Exposure and Risk Estimates for ETU - Foliar.												
Exposure Scenario	Crop or Target	Dermal Unit Exposure ( $\mu\text{g}/\text{lb ai}$ ) <sup>1</sup>	Level of PPE or Engineering control	Inhalation Unit Exposure ( $\mu\text{g}/\text{lb ai}$ ) <sup>1</sup>	Level of PPE or Engineering control <sup>1</sup>	Maximum Application Rate ( $\text{lb ai}/\text{A}$ ) <sup>2</sup>	Area Treated or Amount Handled Daily (acres) <sup>3</sup>	Dermal		Inhalation		Total
								Total Dose ( $\text{mg}/\text{kg}/\text{day}$ ) <sup>4</sup>	MOE <sup>5</sup>	Total Dose <sup>6</sup> ( $\text{mg}/\text{kg}/\text{day}$ )	MOE <sup>7</sup>	MOE <sup>8</sup>
<b>Mixer/Loader/Applicator</b>												
Dry Flowable, Backpack, Broadcast	Greenhouse (ornamentals, roses, cut flowers, container stock, vegetables)	11200	SL/G	140	No-R	0.011 lb ai/gallon solution	7 gallons solution	0.00000873	23000	0.0000103	19000	10000
Dry Flowable, Backpack, Broadcast (foliar)	Nursery (ornamentals, vegetables, trees, container stock)	30500	SL/G	69.1	No-R	0.011 lb ai/gallon solution	15 gallons solution	0.0000509	3900	0.0000108	19000	3200
Dry Flowable, Manually-pressurized Handwand, Broadcast	Greenhouse (ornamentals, roses, cut flowers, container stock, vegetables)	430	SL/G	23.6	No-R	0.048 lb ai/gallon solution	7 gallons solution	0.00000146	140000	0.00000753	27000	23000
Dry Flowable, Manually-pressurized Handwand, Broadcast (foliar)	Nursery (ornamentals, vegetables, trees, container stock)	430	SL/G	23.6	No-R	0.011 lb ai/gallon solution	15 gallons solution	0.000000719	280000	0.0000037	54000	45000
Dry Flowable, Mechanically-pressurized Handgun, Broadcast (foliar)	Orchard/Vineyard	1360	DL/G	0.868	PF10 R	0.048 lb ai/gallon solution	1000 gallons solution	0.000661	300	0.0000396	5100	280
Dry Flowable, Mechanically-pressurized Handgun, Broadcast	Greenhouse (ornamentals, roses, cut flowers, container stock, vegetables)	3610	SL/G	44.8	PF10 R	0.011 lb ai/gallon solution	175 gallons solution	0.0000704	2800	0.0000819	2400	1300
Dry Flowable, Mechanically-pressurized Handgun, Broadcast	Golf course (fairways, tees, greens)	1400	SL/G	42	No-R	0.4	5	0.0000284	7000	0.0000798	2500	1800
Dry Flowable, Mechanically-pressurized Handgun, Broadcast (foliar)	Nursery (ornamentals, vegetables, trees, container stock)	3610	SL/G	44.8	PF10 R	0.011 lb ai/gallon solution	300 gallons solution	0.00012	1700	0.000141	1400	770

Table F-3. Occupational Handler Non-Cancer Exposure and Risk Estimates for ETU - Foliar.												
Exposure Scenario	Crop or Target	Dermal Unit Exposure ( $\mu\text{g}/\text{lb ai}$ ) <sup>1</sup>	Level of PPE or Engineering control	Inhalation Unit Exposure ( $\mu\text{g}/\text{lb ai}$ ) <sup>1</sup>	Level of PPE or Engineering control <sup>1</sup>	Maximum Application Rate ( $\text{lb ai}/\text{A}$ ) <sup>2</sup>	Area Treated or Amount Handled Daily (acres) <sup>3</sup>	Dermal		Inhalation		Total
								Total Dose ( $\text{mg}/\text{kg}/\text{day}$ ) <sup>4</sup>	MOE <sup>5</sup>	Total Dose <sup>6</sup> ( $\text{mg}/\text{kg}/\text{day}$ )	MOE <sup>7</sup>	MOE <sup>8</sup>
Dry Flowable, Mechanically-pressurized Handgun, Broadcast (foliar)	Field crop, typical	1360	DL/G	0.868	PF10 R	0.48 lb ai/gallon solution	1000 gallons solution	0.00661	30	0.000396	510	28
Liquid, Backpack, Broadcast	Greenhouse (ornamentals, roses, cut flowers, container stock, vegetables)	11200	SL/G	140	No-R	0.012 lb ai/gallon solution	7 gallons solution	0.00000953	21000	0.0000112	18000	9700
Liquid, Backpack, Broadcast (foliar)	Nursery (ornamentals, vegetables, trees, container stock)	30500	SL/G	69.1	No-R	0.012 lb ai/gallon solution	15 gallons solution	0.0000556	3600	0.0000118	17000	3000
Liquid, Manually-pressurized Handwand, Broadcast	Greenhouse (ornamentals, roses, cut flowers, container stock, vegetables)	430	SL/G	23.6	No-R	0.012 lb ai/gallon solution	7 gallons solution	0.000000366	550000	0.00000188	110000	92000
Liquid, Manually-pressurized Handwand, Broadcast (foliar)	Nursery (ornamentals, vegetables, trees, container stock)	430	SL/G	23.6	No-R	0.012 lb ai/gallon solution	15 gallons solution	0.000000784	260000	0.00000404	50000	42000
Liquid, Mechanically-pressurized Handgun, Broadcast (foliar)	Orchard/Vineyard	1360	DL/G	0.868	PF10 R	0.48 lb ai/gallon solution	1000 gallons solution	0.00661	30	0.000396	510	28
Liquid, Mechanically-pressurized Handgun, Broadcast	Greenhouse (ornamentals, roses, cut flowers, container stock, vegetables)	3610	SL/G	44.8	PF10 R	0.012 lb ai/gallon solution	175 gallons solution	0.0000767	2600	0.0000894	2200	1200
Liquid, Mechanically-pressurized Handgun, Broadcast	Golf course (fairways, tees, greens)	450	DL/G	1.9	No-R	17.4	5	0.000397	500	0.000157	1300	360
Liquid, Mechanically-pressurized Handgun, Broadcast (foliar)	Nursery (ornamentals, vegetables, trees, container stock)	3610	SL/G	44.8	PF10 R	0.012 lb ai/gallon solution	300 gallons solution	0.000132	1500	0.000153	1300	700
Liquid, Mechanically-pressurized Handgun, Broadcast (foliar)	Field crop, typical	1360	DL/G	0.868	PF10 R	0.48 lb ai/gallon solution	1000 gallons solution	0.00661	30	0.000396	510	28

Table F-3. Occupational Handler Non-Cancer Exposure and Risk Estimates for ETU - Foliar.												
Exposure Scenario	Crop or Target	Dermal Unit Exposure ( $\mu\text{g}/\text{lb ai}$ ) <sup>1</sup>	Level of PPE or Engineering control	Inhalation Unit Exposure ( $\mu\text{g}/\text{lb ai}$ ) <sup>1</sup>	Level of PPE or Engineering control <sup>1</sup>	Maximum Application Rate ( $\text{lb ai}/\text{A}$ ) <sup>2</sup>	Area Treated or Amount Handled Daily (acres) <sup>3</sup>	Dermal		Inhalation		Total
								Total Dose ( $\text{mg}/\text{kg}/\text{day}$ ) <sup>4</sup>	MOE <sup>5</sup>	Total Dose <sup>6</sup> ( $\text{mg}/\text{kg}/\text{day}$ )	MOE <sup>7</sup>	MOE <sup>8</sup>
Wettable Powder, Backpack, Broadcast	Greenhouse (ornamentals, roses, cut flowers, container stock, vegetables)	11200	SL/G	140	No-R	0.016 lb ai/gallon solution	7 gallons solution	0.0000127	16000	0.0000149	13000	7200
Wettable Powder, Backpack, Broadcast (foliar)	Nursery (ornamentals, vegetables, trees, container stock)	30500	SL/G	69.1	No-R	0.016 lb ai/gallon solution	15 gallons solution	0.0000741	2700	0.0000158	13000	2200
Wettable Powder, Manually-pressurized Handwand, Broadcast	Greenhouse (ornamentals, roses, cut flowers, container stock, vegetables)	430	SL/G	23.6	No-R	0.016 lb ai/gallon solution	15 gallons solution	0.000000488	410000	0.00000251	80000	67000
Wettable Powder, Manually-pressurized Handwand, Broadcast (foliar)	Nursery (ornamentals, vegetables, trees, container stock)	430	SL/G	23.6	No-R	0.016 lb ai/gallon solution	40 gallons solution	0.00000104	190000	0.00000538	37000	31000
Wettable Powder, Mechanically-pressurized Handgun, Broadcast (foliar)	Orchard/Vineyard	1360	DL/G	0.868	PF10 R	0.096 lb ai/gallon solution	175 gallons solution	0.00661	<b>30</b>	0.000396	510	<b>28</b>
Wettable Powder, Mechanically-pressurized Handgun, Broadcast	Greenhouse (ornamentals, roses, cut flowers, container stock, vegetables)	3610	SL/G	44.8	PF10 R	0.016 lb ai/gallon solution	300 gallons solution	0.000102	2000	0.000119	1700	920
Wettable Powder, Mechanically-pressurized Handgun, Broadcast (foliar)	Nursery (ornamentals, vegetables, trees, container stock)	3610	SL/G	44.8	PF10 R	0.016 lb ai/gallon solution	1000 gallons solution	0.000175	1100	0.000204	980	520
Wettable Powder, Mechanically-pressurized Handgun, Broadcast (foliar)	Field crop, typical	1360	DL/G	0.868	PF10 R	0.48 lb ai/gallon solution	7 gallons solution	0.00661	<b>30</b>	0.000396	510	<b>28</b>
Water-soluble Packet, Backpack, Broadcast	Greenhouse (ornamentals, roses, cut flowers, container stock, vegetables)	11200	SL/G	140	No-R	0.021 lb ai/gallon solution	15 gallons solution	0.0000167	12000	0.0000196	10000	5500

Table F-3. Occupational Handler Non-Cancer Exposure and Risk Estimates for ETU - Foliar.												
Exposure Scenario	Crop or Target	Dermal Unit Exposure ( $\mu\text{g}/\text{lb ai}$ ) <sup>1</sup>	Level of PPE or Engineering control	Inhalation Unit Exposure ( $\mu\text{g}/\text{lb ai}$ ) <sup>1</sup>	Level of PPE or Engineering control <sup>1</sup>	Maximum Application Rate ( $\text{lb ai}/\text{A}$ ) <sup>2</sup>	Area Treated or Amount Handled Daily (acres) <sup>3</sup>	Dermal		Inhalation		Total
								Total Dose ( $\text{mg}/\text{kg}/\text{day}$ ) <sup>4</sup>	MOE <sup>5</sup>	Total Dose <sup>6</sup> ( $\text{mg}/\text{kg}/\text{day}$ )	MOE <sup>7</sup>	MOE <sup>8</sup>
Water-soluble Packet, Backpack, Broadcast (foliar)	Nursery (ornamentals, vegetables, trees, container stock)	30500	SL/G	69.1	No-R	0.021 lb ai/gallon solution	40 gallons solution	0.0000973	2100	0.0000207	9700	1700
Water-soluble Packet, Manually-pressurized Handwand, Broadcast	Greenhouse (ornamentals, roses, cut flowers, container stock, vegetables)	430	SL/G	23.6	No-R	0.021 lb ai/gallon solution	40 gallons solution	0.00000064	310000	0.0000033	61000	51000
Water-soluble Packet, Manually-pressurized Handwand, Broadcast (foliar)	Nursery (ornamentals, vegetables, trees, container stock)	430	SL/G	23.6	No-R	0.021 lb ai/gallon solution	40 gallons solution	0.00000137	150000	0.00000706	28000	24000
Water-soluble Packet, Mechanically-pressurized Handgun, Broadcast	Greenhouse (ornamentals, roses, cut flowers, container stock, vegetables)	3610	SL/G	44.8	PF10 R	0.021 lb ai/gallon solution	300 gallons solution	0.000135	1500	0.000157	1300	700
Water-soluble Packet, Mechanically-pressurized Handgun, Broadcast	Golf course (fairways, tees, greens)	855	SL/G	18	No-R	0.048 lb ai/gallon solution	1000 gallons solution	0.00000208	96000	0.0000041	49000	32000
Water-soluble Packet, Mechanically-pressurized Handgun, Broadcast (foliar)	Nursery (ornamentals, vegetables, trees, container stock)	3610	SL/G	44.8	PF10 R	0.021	5	0.00023	870	0.000268	750	400

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 PPE: SL/G, DL/G, No-R, PF10, EC = single layer/gloves, double layer/gloves, no-respirator, PF10 respirator, engineering controls.

2 Based on registered labels (see Appendix D).

3 Exposure Science Advisory Council Policy #9.1.

4 Total Dermal Dose = ETU Dermal Dose ( $\text{mg}/\text{kg}/\text{day}$ ) + Metabolized ETU Dermal Dose ( $\text{mg}/\text{kg}/\text{day}$ )

*ETU Dermal Dose* = Dermal Unit Exposure ( $\mu\text{g}/\text{lb ai}$ )  $\times$  Conversion Factor (0.001  $\text{mg}/\mu\text{g}$ )  $\times$  [Tank Mix Conversion (0.001 for mixer/loader) or (0.002 for applicator or M/L/A)]  $\times$  Application Rate (lb ai/acre or gal)  $\times$  Area Treated or Amount Handled (A or gal/day)  $\times$  DAF (6%)  $\div$  BW (80 kg).

*Metabolized ETU Dermal Dose* = Dermal Unit Exposure ( $\mu\text{g}/\text{lb ai}$ )  $\times$  Conversion Factor (0.001  $\text{mg}/\mu\text{g}$ )  $\times$  Metabolic Conversion Factor (7.5%)\*  $\times$  Application Rate (lb ai/acre or gal)  $\times$  Area Treated or Amount Handled (A or gal/day)  $\times$  DAF (1%)  $\div$  BW (kg).

5 Dermal MOE = Dermal POD (0.2  $\text{mg}/\text{kg}/\text{day}$ )  $\div$  Total Dermal Dose ( $\text{mg}/\text{kg}/\text{day}$ ).

6 Total Inhalation Dose = ETU Inhalation dose ( $\text{mg}/\text{kg}/\text{day}$ ) + Metabolized ETU Inhalation Dose ( $\text{mg}/\text{kg}/\text{day}$ )

*ETU Inhalation Dose* = Inhalation Unit Exposure (µg/lb ai) × Conversion Factor (0.001 mg/µg) × [Tank Mix Conversion (0.001 for mixer/loader) or (0.002 for applicator or M/L/A)]\* × Application Rate (lb ai/acre or gal) × Area Treated or Amount Handled (A or gal/day) ÷ BW (80 kg).

*Metabolized ETU Dose* = Inhalation Unit Exposure (µg/lb ai) × Conversion Factor (0.001 mg/µg) × Metabolic Conversion Factor (7.5%)\* × Application Rate (lb ai/acre or gal) × Area Treated or Amount Handled (A or gal/day) ÷ BW (80 kg).

7 Inhalation MOE = Inhalation POD (0.21 mg/kg/day) ÷ Total Inhalation Dose (mg/kg/day).

8 Total MOE = POD (0.21 mg/kg/day) ÷ Total Dermal Dose + Total Inhalation Dose OR Total MOE = 1 ÷ (1/Dermal MOE + 1/Inhalation MOE).

\* See section 4.0 for further details.

Table F-4. Occupational Handler Non-Cancer Exposure and Risk Estimates for ETU – Seed Treatment.								
Crop/Target Category	Specialized Treatment or Formulation	Worker Activity	Application Rate (lb ai/lb seed) <sup>1</sup>	Exposure Variable <sup>2</sup>	Combined MOE <sup>3,4,5,6,7,8,9</sup> (LOC = 300)			
					SL/G + No-R	DL/G + No-R	SL/G + PF10	DL/G + PF10
<b>Commercial Seed Treatment</b>								
Barley	NA	Treating	0.0315	360,000 (AST)	11	12	28	33
		Packaging			4.9	5	34	37
		Cleaning			7.6	8.1	11	11
		Loading/Planting			4.6	4.8	23	28
Corn, field	NA	Treating	0.0405	339,500 (AST)	8.9	9.4	23	27
		Packaging			4.1	4.1	29	31
		Cleaning			5.9	6.3	8.1	8.8
		Loading/Planting			12	12	57	72
Cotton	NA	Treating	0.045	125,000 (AST)	21	23	56	65
		Packaging			9.5	9.6	68	73
		Cleaning			5.3	5.7	7.2	7.9
		Loading/Planting			17	17	84	100
Flax	NA	Treating	0.0533	125,000 (AST)	18	19	47	55
		Packaging			8.4	8.5	59	64
		Cleaning			4.5	4.8	6.1	6.7
		Loading/Planting			13	14	67	82
Oat	NA	Treating	0.0473	360,000 (AST)	7	7.3	19	21
		Packaging			3.2	3.3	23	25
		Cleaning			5.1	5.4	6.9	7.5
		Loading/Planting			3.3	3.4	16	20
Peanut	NA	Treating	0.12	126,000 (AST)	8.2	8.7	21	25
		Packaging			3.7	3.8	26	28
		Cleaning			2	2.1	2.7	3
		Loading/Planting			1.2	1.3	6.2	7.7
Potato	NA	Treating	0.0008	800,000 (AST)	190	200	490	570
		Packaging			87	88	600	660
		Cleaning			300	320	400	450
		Loading/Planting			8.3	8.7	41	51
Rice	NA	Treating	0.032	302,500 (AST)	12	13	33	38
		Packaging			5.7	5.8	40	44
		Cleaning			7.6	8.1	11	11
		Loading/Planting			2.8	2.9	14	17

Crop/Target Category	Specialized Treatment or Formulation	Worker Activity	Application Rate (lb ai/lb seed) <sup>1</sup>	Exposure Variable <sup>2</sup>	Combined MOE <sup>3,4,5,6,7,8,9</sup> (LOC = 300)				
					SL/G + No-R	DL/G + No-R	SL/G + PF10	DL/G + PF10	
Rye	NA	Treating	0.027	360,000 (AST)	12	13	33	38	
		Packaging			5.7	5.8	40	44	
		Cleaning			9	9.4	12	13	
		Loading/Planting			5.8	6.1	29	36	
Safflower	NA	Treating	0.015	360,000 (AST)	22	23	59	68	
		Packaging			10	11	73	79	
		Cleaning			16	17	22	24	
		Loading/Planting			67	70	330	410	
Sorghum, grain	NA	Treating	0.0338	360,000 (AST)	9.7	10	26	31	
		Packaging			4.6	4.6	32	34	
		Cleaning			7	7.4	9.6	10	
		Loading/Planting			88	91	430	520	
Tomato	Film-coated	Treating	0.06	3,000 (AST)	670	710	1700	2100	
	Film-coated	Packaging			300	310	2100	2300	
	Film-coated	Cleaning			2.5 hours (AD)	4	4.2	5.5	5.9
	Film-coated	Loading/Planting			10.454.400 (NSP)	540	560	2700	3300
	Encrusted/Pelleted	Treating			225 (AST)	9000	9500	24000	28000
	Encrusted/Pelleted	Packaging			4100	4100	29000	31000	
	Encrusted/Pelleted	Cleaning			2.5 hours (AD)	4	4.2	5.5	5.9
	Encrusted/Pelleted	Loading/Planting			10.454.400 (NSP)	540	560	2700	3300
Triticale	NA	Treating	0.0248	360,000 (AST)	14	14	35	41	
		Packaging			6.3	6.4	44	48	
		Cleaning			9.7	10	13	14	
		Loading/Planting			327,000,000 (NSP)	5.2	5.4	26	32
Wheat	NA	Treating	0.0248	360,000 (AST)	14	14	35	41	
		Packaging			6.3	6.4	44	48	
		Cleaning			9.7	10	13	14	
		Loading/Planting			300,000,000 (NSP)	3.6	3.8	18	22
<b>On-Farm Seed Treatment</b>									
Barley	Liquid	Treating/Planting	0.00209	184,240,000 (NSP)	130	130	820	880	
	Dust/Powder [Solids]		0.00131		11	12	55	65	
Corn, field	Liquid		0.00209	8,050,000 (NSP)	420	430	2700	2900	
Cotton	Liquid		0.003	17,000,000 (NSP)	470	470	3000	3200	
Flax	Liquid		0.003	243,936,000 (NSP)	440	440	2800	3000	
Oat	Liquid		0.00313	234,000,000 (NSP)	93	95	580	640	
	Dust/Powder [Solids]		0.00197		8.2	8.5	39	47	
Peanut	Liquid		0.008	8,400,000 (NSP)	36	36	230	240	
Potato	Liquid		0.000781	2,125,728 (NSP)	16	16	100	110	
	Dust/Powder [Solids]		0.0008		0.85	0.88	4.1	4.9	

**Table F-4. Occupational Handler Non-Cancer Exposure and Risk Estimates for ETU – Seed Treatment.**

Crop/Target Category	Specialized Treatment or Formulation	Worker Activity	Application Rate (lb ai/lb seed) <sup>1</sup>	Exposure Variable <sup>2</sup>	Combined MOE <sup>3,4,5,6,7,8,9</sup> (LOC = 300)			
					SL/G + No-R	DL/G + No-R	SL/G + PF10	DL/G + PF10
Rice	Liquid		0.002	487,672,000 (NSP)	84	85	530	580
	Dust/Powder [Solids]		0.00125		7.4	7.6	36	42
Rye	Liquid		0.00178	324,000,000 (NSP)	160	160	1000	1100
	Dust/Powder [Solids]		0.00113		14	15	69	80
Safflower	Liquid		0.001	38,102,400 (NSP)	1900	1900	12000	13000
	Dust/Powder [Solids]		0.00094		110	110	520	620
Sorghum, grain	Liquid		0.00225	8,000,000 (NSP)	2400	2500	15000	17000
	Dust/Powder [Solids]		0.00094		320	330	1500	1800
Tomato	Liquid		0.004	10,454,400 (NSP)	15000	15000	94000	100000
Triticale	Liquid		0.00163	327,000,000 (NSP)	150	150	940	1000
	Dust/Powder [Solids]		0.00103		13	14	63	75
Wheat	Liquid		0.00163	300,000,000 (NSP)	100	100	650	700
	Dust/Powder [Solids]	0.00103	8.8		9.1	43	50	

<sup>1</sup> Seed Treatment Application rates based on the registered mancozeb labels. See Appendix D.

<sup>2</sup> HED default for lb seed treated/planted per day from HED Exposure Science Advisory Council Policy 15.2 (January 2022). Exposure Variables: Cleaning, Activity Duration (AD, hrs); Packaging and Treating, Amount Seed Treated (AST, lb seed); Loading/Planting, Number of Seeds Planted (NSP, number of seeds).

<sup>3</sup> Unit Exposures from HED Exposure Science Advisory Council Policy 14: Standard Operating Procedures for Seed Treatment.

<sup>4</sup> PPE: SL/G = Single Layer/Gloves, DL/G = Double Layer/Gloves, No-R = No Respirator, and PF10 R = PF10 Respirator

<sup>5</sup> Total Dermal Dose = ETU Dermal Dose (mg/kg/day) + Metabolized ETU Dermal Dose (mg/kg/day)

ETU Dermal Dose

*Commercial Seed Treaters and Packagers:* Dermal Dose = Dermal Unit Exposure (µg/lb ai) × Conversion Factor (0.001 mg/µg) × [Tank Mix Conversion (0.001 for commercial activities) or (0.002 for on farm activities)]\* × Application Rate (lb ai/lb seed) × Amount of Seed Treated (lb seed/day) × DAF (6 %) ÷ BW (80 kg).

*Commercial Seed Treatment Cleaners:* Dermal Dose = Dermal Unit Exposure (µg/lb ai) × Conversion Factor (0.001 mg/µg) × [Tank Mix Conversion (0.001 for commercial activities) or (0.002 for on farm activities)]\* × Application Rate (lb ai/lb seed) × Activity Duration (2.5 hr) × DAF (6 %) ÷ BW (80 kg).

*Commercial Seed Treatment Loading/Planting:* Dermal Dose (mg/kg/day) = Dermal Unit Exposure (mg/day) × Conversion Factor (0.001 mg/µg) × [Tank Mix Conversion (0.001 for commercial activities) or (0.002 for on farm activities)]\* × Application Rate (lb ai/seed) × Number of Seeds Planted (NSP) × Dermal Absorption Factor (6%) ÷ BW (80 kg).

*On-Farm Treaters/Planters:* Dermal Dose = Dermal Unit Exposure (µg/lb ai) × Conversion Factor (0.001 mg/µg) × [Tank Mix Conversion (0.001 for commercial activities) or (0.002 for on farm activities)]\* × Application Rate (lb ai/lb seed) × Number of Seeds Planted (NSP) × DAF (6 %) ÷ BW (80 kg).

Metabolized ETU Dermal Dose

*Commercial Seed Treaters and Packagers:* Dermal Dose = Dermal Unit Exposure (µg/lb ai) × Conversion Factor (0.001 mg/µg) × Metabolic Conversion Factor (7.5%)\* × Application Rate (lb ai/lb seed) × Amount of Seed Treated (lb seed/day) × DAF (6 %) ÷ BW (80 kg).

*Commercial Seed Treatment Cleaners:* Dermal Dose = Dermal Unit Exposure (µg/lb ai) × Conversion Factor (0.001 mg/µg) × Metabolic Conversion Factor (7.5%)\* × Application Rate (lb ai/lb seed) × Activity Duration (2.5 hr) × DAF (6 %) ÷ BW (80 kg).

*Commercial Seed Treatment Loading/Planting:* Dermal Dose (mg/kg/day) = Dermal Unit Exposure (mg/day) × Conversion Factor (0.001 mg/µg) × [Tank Mix Conversion (0.001 for commercial activities) or (0.002 for on farm activities)]\* × Application Rate (lb ai/seed) × Number of Seeds Planted (NSP) × Dermal Absorption Factor (6%) ÷ BW (80 kg).

*On-Farm Treaters/Planters:* Dermal Dose = Dermal Unit Exposure (µg/lb ai) × Conversion Factor (0.001 mg/µg) × Metabolic Conversion Factor (7.5%)\* × Application Rate (lb ai/lb seed) × Number of Seeds Planted (NSP) × DAF (6 %) ÷ BW (80 kg).

<sup>6</sup> Dermal MOE = Dermal POD (0.2 mg/kg/day) ÷ Total Dermal Dose (mg/kg/day).

<sup>7</sup> Total Inhalation Dose = ETU Inhalation dose (mg/kg/day) + Metabolized ETU Inhalation Dose (mg/kg/day)

ETU Inhalation Dose

*Commercial Seed Treaters and Packagers:* Inhalation Dose = Inhalation Unit Exposure (µg/lb ai) × Conversion Factor (0.001 mg/µg) × [Tank Mix Conversion (0.001 for commercial activities) or (0.002 for on farm activities)]\* × Application Rate (lb ai/lb seed) × Amount of Seed Treated (lb seed/day) ÷ BW (80 kg).

*Commercial Seed Treatment Cleaners:* Inhalation Dose = Inhalation Unit Exposure (µg/lb ai) × Conversion Factor (0.001 mg/µg) × [Tank Mix Conversion (0.001 for commercial activities) or (0.002 for on farm activities)]\* × Application Rate (lb ai/lb seed) × Activity Duration (2.5 hr) ÷ BW (80 kg).

*Commercial Seed Treatment Loading/ Planting:* Inhalation Dose (mg/kg/day) = Inhalation Unit Exposure (mg/day) × Conversion Factor (0.001 mg/µg) × [Tank Mix Conversion (0.001 for commercial activities) or (0.002 for on farm activities)]\* × Application Rate (lb ai/seed) × Number of Seeds Planted (NSP) ÷ BW (80 kg).

*On-Farm Treaters/Planters:* Inhalation Dose = Inhalation Unit Exposure (µg/lb ai) × Conversion Factor (0.001 mg/µg) × [Tank Mix Conversion (0.001 for commercial activities) or (0.002 for on farm activities)]\* × Application Rate (lb ai/lb seed) × Number of Seeds Planted (NSP) ÷ BW (80 kg).

Metabolized ETU Dose

*Commercial Seed Treaters and Packagers:* Inhalation Dose = Inhalation Unit Exposure (µg/lb ai) × Conversion Factor (0.001 mg/µg) × Metabolic Conversion Factor (7.5%)\* × Application Rate (lb ai/lb seed) × Amount of Seed Treated (lb seed/day) ÷ BW (80 kg).

*Commercial Seed Treatment Cleaners:* Inhalation Dose = Inhalation Unit Exposure (µg/lb ai) × Conversion Factor (0.001 mg/µg) × Metabolic Conversion Factor (7.5%)\* × Application Rate (lb ai/lb seed) × Activity Duration (2.5 hr) ÷ BW (80 kg).

*Commercial Seed Treatment Loading/ Planting:* Inhalation Dose (mg/kg/day) = Inhalation Unit Exposure (mg/day) × Conversion Factor (0.001 mg/µg) × Metabolic Conversion Factor (7.5%)\* × Application Rate (lb ai/seed) × Number of Seeds Planted (NSP) ÷ BW (80 kg).

*On-Farm Treaters/Planters:* Inhalation Dose = Inhalation Unit Exposure (µg/lb ai) × Conversion Factor (0.001 mg/µg) × Metabolic Conversion Factor (7.5%)\* × Application Rate (lb ai/lb seed) × Number of Seeds Planted (NSP) ÷ BW (80 kg).

<sup>8</sup> Inhalation MOE = Inhalation POD (0.21 mg/kg/day) ÷ Total Inhalation Dose (mg/kg/day).

<sup>9</sup> Total MOE = POD (0.21 mg/kg/day) ÷ Total Dermal Dose + Total Inhalation Dose

\* See section 4.0 for further details.

Exposure Scenario	Crop or Target	Private Handler						Commercial Handler					
		LADD (mg/kg/day)				Total LADD <sup>3</sup>	Cancer Risk Estimate <sup>4</sup>	LADD (mg/kg/day)				Total LADD <sup>3</sup>	Cancer Risk Estimate <sup>4</sup>
		Dermal <sup>1</sup>	PPE	Inhalation <sup>2</sup>	PPE			Dermal <sup>1</sup>	PPE	Inhalation <sup>2</sup>	PPE		
<b>Mixer/Loader</b>													
Dry Flowable, Aerial, Broadcast	Nursery (ornamentals, vegetables, trees, container stock)	0.0000643	SL/G	0.000186	No-R	0.00025	2E-05	0.000193	SL/G	0.000557	No-R	0.000749	5E-05
Dry Flowable, Aerial, Broadcast	Orchard/Vineyard	0.000799	SL/G	0.00232	No-R	0.00312	2E-04	0.0024	SL/G	0.00697	No-R	0.00937	6E-04
Dry Flowable, Aerial, Broadcast	Sod	0.0029	SL/G	0.0084	No-R	0.0113	7E-04	0.0087	SL/G	0.0252	No-R	0.0339	2E-03
Dry Flowable, Aerial, Broadcast	Field crop, typical	0.00075	SL/G	0.00216	No-R	0.00291	2E-04	0.00225	SL/G	0.00649	No-R	0.00874	5E-04
Dry Flowable, Aerial, Broadcast	Field crop, high-acreage	0.000857	SL/G	0.00247	No-R	0.00333	2E-04	0.00257	SL/G	0.00741	No-R	0.00999	6E-04
Dry Flowable, Airblast, Broadcast	Nursery (ornamentals, vegetables, trees, container stock)	0.0000214	SL/G	0.000062	No-R	0.0000834	5E-06	0.0000642	SL/G	0.000186	No-R	0.00025	2E-05

Exposure Scenario	Crop or Target	Private Handler						Commercial Handler					
		LADD (mg/kg/day)				Total LADD <sup>3</sup>	Cancer Risk Estimate <sup>4</sup>	LADD (mg/kg/day)				Total LADD <sup>3</sup>	Cancer Risk Estimate <sup>4</sup>
		Dermal <sup>1</sup>	PPE	Inhalation <sup>2</sup>	PPE			Dermal <sup>1</sup>	PPE	Inhalation <sup>2</sup>	PPE		
Dry Flowable, Airblast, Broadcast	Orchard/Vineyard	0.0000913	SL/G	0.000264	No-R	0.000355	2E-05	0.000274	SL/G	0.000793	No-R	0.00107	6E-05
Dry Flowable, Chemigation, Broadcast	Orchard/Vineyard	0.000799	SL/G	0.00232	No-R	0.00312	2E-04	0.0024	SL/G	0.00697	No-R	0.00937	6E-04
Dry Flowable, Chemigation, Broadcast	Field crop, typical	0.00075	SL/G	0.00216	No-R	0.00291	2E-04	0.00225	SL/G	0.00649	No-R	0.00874	5E-04
Dry Flowable, Chemigation, Broadcast	Field crop, high-acreage	0.00025	SL/G	0.000723	No-R	0.000972	6E-05	0.000749	SL/G	0.00217	No-R	0.00292	2E-04
Dry Flowable, Chemigation, Broadcast	Greenhouse (ornamentals, roses, cut flowers, container stock, vegetables)	0.0000643	SL/G	0.000186	No-R	0.00025	2E-05	0.000193	SL/G	0.000557	No-R	0.000749	5E-05
Dry Flowable, Chemigation, Broadcast	Nursery (ornamentals, vegetables, trees, container stock)	0.0000643	SL/G	0.000186	No-R	0.00025	2E-05	0.000193	SL/G	0.000557	No-R	0.000749	5E-05
Dry Flowable, Groundboom, Broadcast	Golf course (fairways, tees, greens)	0.000331	SL/G	0.000959	No-R	0.00129	8E-05	0.000992	SL/G	0.00288	No-R	0.00387	2E-04
Dry Flowable, Groundboom, Broadcast	Field-grown ornamental crops	0.0000286	SL/G	0.0000827	No-R	0.000111	7E-06	0.0000859	SL/G	0.000248	No-R	0.000334	2E-05
Dry Flowable, Groundboom, Broadcast	Nursery (ornamentals, vegetables, trees, container stock)	0.0000643	SL/G	0.000186	No-R	0.00025	2E-05	0.000193	SL/G	0.000557	No-R	0.000749	5E-05
Dry Flowable, Groundboom, Broadcast	Greenhouse (ornamentals, roses, cut flowers, container stock, vegetables)	0.0000643	SL/G	0.000186	No-R	0.00025	2E-05	0.000193	SL/G	0.000557	No-R	0.000749	5E-05
Dry Flowable, Groundboom, Broadcast	Sod	0.000663	SL/G	0.00192	No-R	0.00258	2E-04	0.00199	SL/G	0.00575	No-R	0.00774	5E-04
Dry Flowable, Groundboom, Broadcast	Orchard/Vineyard	0.0000913	SL/G	0.000264	No-R	0.000355	2E-05	0.000274	SL/G	0.000793	No-R	0.00107	6E-05

Table F-5. Occupational Handler Cancer Exposure and Risk Estimates for ETU -Foliar.													
Exposure Scenario	Crop or Target	Private Handler						Commercial Handler					
		LADD (mg/kg/day)				Total LADD <sup>3</sup>	Cancer Risk Estimate <sup>4</sup>	LADD (mg/kg/day)				Total LADD <sup>3</sup>	Cancer Risk Estimate <sup>4</sup>
		Dermal <sup>1</sup>	PPE	Inhalation <sup>2</sup>	PPE			Dermal <sup>1</sup>	PPE	Inhalation <sup>2</sup>	PPE		
Dry Flowable, Groundboom, Broadcast	Field crop, typical	0.000183	SL/G	0.000529	No-R	0.000712	4E-05	0.00055	SL/G	0.00159	No-R	0.00214	1E-04
Dry Flowable, Groundboom, Broadcast	Field crop, high-acreage	0.000143	SL/G	0.000413	No-R	0.000556	3E-05	0.000428	SL/G	0.00124	No-R	0.00167	1E-04
Liquid, Aerial, Broadcast	Nursery (ornamentals, vegetables, trees, container stock)	0.000025	SL/G	0.00000243	No-R	0.0000274	2E-06	0.0000749	SL/G	0.0000073	No-R	0.0000822	5E-06
Liquid, Aerial, Broadcast	Orchard/Vineyard	0.000583	SL/G	0.0000566	No-R	0.000639	4E-05	0.00175	SL/G	0.00017	No-R	0.00192	1E-04
Liquid, Aerial, Broadcast	Sod	0.00211	SL/G	0.000204	No-R	0.00232	1E-04	0.00634	SL/G	0.000612	No-R	0.00697	4E-04
Liquid, Aerial, Broadcast	Field crop, typical	0.000583	SL/G	0.0000566	No-R	0.000639	4E-05	0.00175	SL/G	0.00017	No-R	0.00192	1E-04
Liquid, Aerial, Broadcast	Field crop, high-acreage	0.000666	SL/G	0.0000645	No-R	0.000731	4E-05	0.002	SL/G	0.000194	No-R	0.00219	1E-04
Liquid, Airblast, Broadcast	Nursery (ornamentals, vegetables, trees, container stock)	0.00000832	SL/G	0.000000809	No-R	0.00000913	6E-07	0.000025	SL/G	0.00000243	No-R	0.0000274	2E-06
Liquid, Airblast, Broadcast	Orchard/Vineyard	0.0000666	SL/G	0.00000645	No-R	0.0000731	4E-06	0.0002	SL/G	0.0000194	No-R	0.000219	1E-05
Liquid, Chemigation, Broadcast	Orchard/Vineyard	0.000583	SL/G	0.0000566	No-R	0.000639	4E-05	0.00175	SL/G	0.00017	No-R	0.00192	1E-04
Liquid, Chemigation, Broadcast	Sod	0.00211	SL/G	0.000204	No-R	0.00232	1E-04	0.00634	SL/G	0.000612	No-R	0.00697	4E-04
Liquid, Chemigation, Broadcast	Field crop, typical	0.000583	SL/G	0.0000566	No-R	0.000639	4E-05	0.00175	SL/G	0.00017	No-R	0.00192	1E-04
Liquid, Chemigation, Broadcast	Field crop, high-acreage	0.000194	SL/G	0.0000189	No-R	0.000213	1E-05	0.000583	SL/G	0.0000568	No-R	0.000638	4E-05
Liquid, Chemigation, Broadcast	Greenhouse (ornamentals, roses, cut flowers, container stock, vegetables)	0.000025	SL/G	0.00000243	No-R	0.0000274	2E-06	0.0000749	SL/G	0.0000073	No-R	0.0000822	5E-06

Exposure Scenario	Crop or Target	Private Handler						Commercial Handler					
		LADD (mg/kg/day)				Total LADD <sup>3</sup>	Cancer Risk Estimate <sup>4</sup>	LADD (mg/kg/day)				Total LADD <sup>3</sup>	Cancer Risk Estimate <sup>4</sup>
		Dermal <sup>1</sup>	PPE	Inhalation <sup>2</sup>	PPE			Dermal <sup>1</sup>	PPE	Inhalation <sup>2</sup>	PPE		
Liquid, Chemigation, Broadcast	Nursery (ornamentals, vegetables, trees, container stock)	0.000025	SL/G	0.00000243	No-R	0.0000274	2E-06	0.0000749	SL/G	0.0000073	No-R	0.0000822	5E-06
Liquid, Groundboom, Broadcast	Golf course (fairways, tees, greens)	0.000242	SL/G	0.0000234	No-R	0.000266	2E-05	0.000727	SL/G	0.0000701	No-R	0.000797	5E-05
Liquid, Groundboom, Broadcast	Field-grown ornamental crops	0.0000166	SL/G	0.00000161	No-R	0.0000182	1E-06	0.0000498	SL/G	0.00000483	No-R	0.0000546	3E-06
Liquid, Groundboom, Broadcast	Nursery (ornamentals, vegetables, trees, container stock)	0.000025	SL/G	0.00000243	No-R	0.0000274	2E-06	0.0000749	SL/G	0.0000073	No-R	0.0000822	5E-06
Liquid, Groundboom, Broadcast	Greenhouse (ornamentals, roses, cut flowers, container stock, vegetables)	0.000025	SL/G	0.00000243	No-R	0.0000274	2E-06	0.0000749	SL/G	0.0000073	No-R	0.0000822	5E-06
Liquid, Groundboom, Broadcast	Sod	0.000482	SL/G	0.0000468	No-R	0.000529	3E-05	0.00145	SL/G	0.000141	No-R	0.00159	1E-04
Liquid, Groundboom, Broadcast	Orchard/Vineyard	0.0000666	SL/G	0.00000645	No-R	0.0000731	4E-06	0.0002	SL/G	0.0000194	No-R	0.000219	1E-05
Liquid, Groundboom, Broadcast	Field crop, typical	0.000133	SL/G	0.0000129	No-R	0.000146	9E-06	0.000398	SL/G	0.0000387	No-R	0.000439	3E-05
Liquid, Groundboom, Broadcast	Field crop, high-acreage	0.000111	SL/G	0.0000108	No-R	0.000121	7E-06	0.000332	SL/G	0.0000323	No-R	0.000364	2E-05
Wettable Powder, Aerial, Broadcast	Nursery (ornamentals, vegetables, trees, container stock)	0.0000509	SL/G	0.0000406	No-R	0.0000915	6E-06	0.000153	SL/G	0.000122	No-R	0.000274	2E-05
Wettable Powder, Aerial, Broadcast	Orchard/Vineyard	0.000891	SL/G	0.000711	No-R	0.0016	1E-04	0.00267	SL/G	0.00213	No-R	0.00479	3E-04
Wettable Powder, Aerial, Broadcast	Field crop, typical	0.000891	SL/G	0.000711	No-R	0.0016	1E-04	0.00267	SL/G	0.00213	No-R	0.00479	3E-04
Wettable Powder, Aerial, Broadcast	Field crop, high-acreage	0.00101	SL/G	0.000811	No-R	0.00183	1E-04	0.00304	SL/G	0.00243	No-R	0.0055	3E-04

Table F-5. Occupational Handler Cancer Exposure and Risk Estimates for ETU -Foliar.													
Exposure Scenario	Crop or Target	Private Handler						Commercial Handler					
		LADD (mg/kg/day)				Total LADD <sup>3</sup>	Cancer Risk Estimate <sup>4</sup>	LADD (mg/kg/day)				Total LADD <sup>3</sup>	Cancer Risk Estimate <sup>4</sup>
		Dermal <sup>1</sup>	PPE	Inhalation <sup>2</sup>	PPE			Dermal <sup>1</sup>	PPE	Inhalation <sup>2</sup>	PPE		
Wettable Powder, Airblast, Broadcast	Nursery (ornamentals, vegetables, trees, container stock)	0.000017	SL/G	0.0000135	No-R	0.0000305	2E-06	0.0000509	SL/G	0.0000406	No-R	0.0000915	6E-06
Wettable Powder, Airblast, Broadcast	Orchard/Vineyard	0.000101	SL/G	0.0000811	No-R	0.000183	1E-05	0.000304	SL/G	0.000243	No-R	0.00055	3E-05
Wettable Powder, Chemigation, Broadcast	Orchard/Vineyard	0.000891	SL/G	0.000711	No-R	0.0016	1E-04	0.00267	SL/G	0.00213	No-R	0.00479	3E-04
Wettable Powder, Chemigation, Broadcast	Field crop, typical	0.000891	SL/G	0.000711	No-R	0.0016	1E-04	0.00267	SL/G	0.00213	No-R	0.00479	3E-04
Wettable Powder, Chemigation, Broadcast	Field crop, high-acreage	0.000298	SL/G	0.000237	No-R	0.000535	3E-05	0.000893	SL/G	0.000712	No-R	0.0016	1E-04
Wettable Powder, Chemigation, Broadcast	Greenhouse (ornamentals, roses, cut flowers, container stock, vegetables)	0.0000509	SL/G	0.0000406	No-R	0.0000915	6E-06	0.000153	SL/G	0.000122	No-R	0.000274	2E-05
Wettable Powder, Chemigation, Broadcast	Nursery (ornamentals, vegetables, trees, container stock)	0.0000509	SL/G	0.0000406	No-R	0.0000915	6E-06	0.000153	SL/G	0.000122	No-R	0.000274	2E-05
Wettable Powder, Groundboom, Broadcast	Field-grown ornamental crops	0.0000339	SL/G	0.000027	No-R	0.000061	4E-06	0.000102	SL/G	0.0000811	No-R	0.000183	1E-05
Wettable Powder, Groundboom, Broadcast	Nursery (ornamentals, vegetables, trees, container stock)	0.0000509	SL/G	0.0000406	No-R	0.0000915	6E-06	0.000153	SL/G	0.000122	No-R	0.000274	2E-05
Wettable Powder, Groundboom, Broadcast	Greenhouse (ornamentals, roses, cut flowers, container stock, vegetables)	0.0000509	SL/G	0.0000406	No-R	0.0000915	6E-06	0.000153	SL/G	0.000122	No-R	0.000274	2E-05

Table F-5. Occupational Handler Cancer Exposure and Risk Estimates for ETU -Foliar.													
Exposure Scenario	Crop or Target	Private Handler						Commercial Handler					
		LADD (mg/kg/day)				Total LADD <sup>3</sup>	Cancer Risk Estimate <sup>4</sup>	LADD (mg/kg/day)				Total LADD <sup>3</sup>	Cancer Risk Estimate <sup>4</sup>
		Dermal <sup>1</sup>	PPE	Inhalation <sup>2</sup>	PPE			Dermal <sup>1</sup>	PPE	Inhalation <sup>2</sup>	PPE		
Wettable Powder, Groundboom, Broadcast	Orchard/Vineyard	0.000101	SL/G	0.0000811	No-R	0.000183	1E-05	0.000304	SL/G	0.000243	No-R	0.00055	3E-05
Wettable Powder, Groundboom, Broadcast	Field crop, typical	0.000204	SL/G	0.000164	No-R	0.000368	2E-05	0.000612	SL/G	0.000491	No-R	0.0011	7E-05
Wettable Powder, Groundboom, Broadcast	Field crop, high-acreage	0.00017	SL/G	0.000135	No-R	0.000305	2E-05	0.000509	SL/G	0.000406	No-R	0.000915	6E-05
Water-soluble Packet, Airblast, Broadcast	Nursery (ornamentals, vegetables, trees, container stock)	0.00000332	EC/G	0.0000115	EC/No-R	0.0000149	9E-07	0.00000996	EC/G	0.00000345	EC/PF10R	0.0000134	8E-07
Water-soluble Packet, Groundboom, Broadcast	Golf course (fairways, tees, greens)	0.0000482	EC/G	0.000167	EC/No-R	0.000215	1E-05	0.000145	EC/G	0.0000502	EC/PF10R	0.000195	1E-05
Water-soluble Packet, Groundboom, Broadcast	Field-grown ornamental crops	0.00000664	EC/G	0.0000231	EC/No-R	0.0000298	2E-06	0.0000199	EC/G	0.00000693	EC/PF10R	0.0000268	2E-06
Water-soluble Packet, Groundboom, Broadcast	Nursery (ornamentals, vegetables, trees, container stock)	0.0000143	EC/G	0.0000492	EC/No-R	0.0000634	4E-06	0.0000428	EC/G	0.0000148	EC/PF10R	0.0000575	3E-06
Water-soluble Packet, Groundboom, Broadcast	Greenhouse (ornamentals, roses, cut flowers, container stock, vegetables)	0.0000143	EC/G	0.0000492	EC/No-R	0.0000634	4E-06	0.0000428	EC/G	0.0000148	EC/PF10R	0.0000575	3E-06
<b>Applicator</b>													
Spray (all starting formulations), Aerial, Broadcast	Nursery (ornamentals, vegetables, trees, container stock)	0.00000139	EC/G	5.42E-08	EC/No-R	0.00000144	9E-08	0.00000417	EC/G	0.000000163	EC/No-R	0.00000432	3E-07
Spray (all starting formulations), Aerial, Broadcast	Orchard/Vineyard	0.0000322	EC/G	0.00000127	EC/No-R	0.0000334	2E-06	0.0000966	EC/G	0.0000038	EC/No-R	0.0001	6E-06

Table F-5. Occupational Handler Cancer Exposure and Risk Estimates for ETU -Foliar.													
Exposure Scenario	Crop or Target	Private Handler						Commercial Handler					
		LADD (mg/kg/day)				Total LADD <sup>3</sup>	Cancer Risk Estimate <sup>4</sup>	LADD (mg/kg/day)				Total LADD <sup>3</sup>	Cancer Risk Estimate <sup>4</sup>
		Dermal <sup>1</sup>	PPE	Inhalation <sup>2</sup>	PPE			Dermal <sup>1</sup>	PPE	Inhalation <sup>2</sup>	PPE		
Spray (all starting formulations), Aerial, Broadcast	Sod	0.000117	EC/G	0.00000459	EC/No-R	0.000122	7E-06	0.000351	EC/G	0.0000138	EC/No-R	0.000365	2E-05
Spray (all starting formulations), Aerial, Broadcast	Field crop, typical	0.0000322	EC/G	0.00000127	EC/No-R	0.0000334	2E-06	0.0000966	EC/G	0.0000038	EC/No-R	0.0001	6E-06
Spray (all starting formulations), Aerial, Broadcast	Field crop, high-acreage	0.0000368	EC/G	0.00000145	EC/No-R	0.0000382	2E-06	0.00011	EC/G	0.00000435	EC/No-R	0.000115	7E-06
Spray (all starting formulations), Airblast, Broadcast	Nursery (ornamentals, vegetables, trees, container stock)	0.00066	SL/G	0.0000326	No-R	0.000693	4E-05	0.00198	SL/G	0.0000977	No-R	0.00208	1E-04
Spray (all starting formulations), Airblast, Broadcast	Orchard/Vineyard	0.00282	SL/G	0.000139	No-R	0.00295	2E-04	0.00845	SL/G	0.000417	No-R	0.00885	5E-04
Spray (all starting formulations), Groundboom, Broadcast	Golf course (fairways, tees, greens)	0.000103	SL/G	0.0000364	No-R	0.00014	8E-06	0.00031	SL/G	0.000109	No-R	0.00042	3E-05
Spray (all starting formulations), Groundboom, Broadcast	Field-grown ornamental crops	0.0000095	SL/G	0.00000336	No-R	0.0000129	8E-07	0.0000285	SL/G	0.0000101	No-R	0.0000387	2E-06
Spray (all starting formulations), Groundboom, Broadcast	Nursery (ornamentals, vegetables, trees, container stock)	0.00002	SL/G	0.00000706	No-R	0.000027	2E-06	0.0000601	SL/G	0.0000212	No-R	0.0000811	5E-06

Table F-5. Occupational Handler Cancer Exposure and Risk Estimates for ETU -Foliar.													
Exposure Scenario	Crop or Target	Private Handler						Commercial Handler					
		LADD (mg/kg/day)				Total LADD <sup>3</sup>	Cancer Risk Estimate <sup>4</sup>	LADD (mg/kg/day)				Total LADD <sup>3</sup>	Cancer Risk Estimate <sup>4</sup>
		Dermal <sup>1</sup>	PPE	Inhalation <sup>2</sup>	PPE			Dermal <sup>1</sup>	PPE	Inhalation <sup>2</sup>	PPE		
Spray (all starting formulations), Groundboom, Broadcast	Greenhouse (ornamentals, roses, cut flowers, container stock, vegetables)	0.00002	SL/G	0.00000706	No-R	0.000027	2E-06	0.0000601	SL/G	0.0000212	No-R	0.0000811	5E-06
Spray (all starting formulations), Groundboom, Broadcast	Sod	0.000207	SL/G	0.0000727	No-R	0.000279	2E-05	0.00062	SL/G	0.000218	No-R	0.000837	5E-05
Spray (all starting formulations), Groundboom, Broadcast	Orchard/Vineyard	0.0000285	SL/G	0.00001	No-R	0.0000386	2E-06	0.0000856	SL/G	0.0000301	No-R	0.000116	7E-06
Spray (all starting formulations), Groundboom, Broadcast	Field crop, typical	0.000057	SL/G	0.0000202	No-R	0.0000772	5E-06	0.000171	SL/G	0.0000605	No-R	0.000232	1E-05
Spray (all starting formulations), Groundboom, Broadcast	Field crop, high-acreage	0.0000475	SL/G	0.0000167	No-R	0.0000642	4E-06	0.000142	SL/G	0.0000502	No-R	0.000193	1E-05
<b>Flagger</b>													
Spray (all starting formulations), Aerial, Broadcast	Nursery (ornamentals, vegetables, trees, container stock)	0.000032	SL/G	0.00000895	No-R	0.0000409	2E-06	0.0000959	SL/G	0.0000268	No-R	0.000123	7E-06
Spray (all starting formulations), Aerial, Broadcast	Orchard/Vineyard	0.000187	SL/G	0.0000521	No-R	0.000238	1E-05	0.000561	SL/G	0.000156	No-R	0.000715	4E-05
Spray (all starting formulations), Aerial, Broadcast	Sod	0.000674	SL/G	0.000189	No-R	0.000863	5E-05	0.00202	SL/G	0.000568	No-R	0.00259	2E-04

Table F-5. Occupational Handler Cancer Exposure and Risk Estimates for ETU -Foliar.													
Exposure Scenario	Crop or Target	Private Handler						Commercial Handler					
		LADD (mg/kg/day)				Total LADD <sup>3</sup>	Cancer Risk Estimate <sup>4</sup>	LADD (mg/kg/day)				Total LADD <sup>3</sup>	Cancer Risk Estimate <sup>4</sup>
		Dermal <sup>1</sup>	PPE	Inhalation <sup>2</sup>	PPE			Dermal <sup>1</sup>	PPE	Inhalation <sup>2</sup>	PPE		
Spray (all starting formulations), Aerial, Broadcast	Field crop, typical	0.000187	SL/G	0.0000521	No-R	0.000238	1E-05	0.000561	SL/G	0.000156	No-R	0.000715	4E-05
Spray (all starting formulations), Aerial, Broadcast	Field crop, high-acreage	0.000062	SL/G	0.0000173	No-R	0.0000793	5E-06	0.000186	SL/G	0.000052	No-R	0.000238	1E-05
Mixer/Loader/Applicator													
Dry Flowable, Backpack, Broadcast	Greenhouse (ornamentals, roses, cut flowers, container stock, vegetables)	0.00000795	SL/G	0.00000166	No-R	0.00000961	6E-07	0.0000239	SL/G	0.00000498	No-R	0.0000288	2E-06
Dry Flowable, Backpack, Broadcast (foliar)	Nursery (ornamentals, vegetables, trees, container stock)	0.0000463	SL/G	0.00000176	No-R	0.0000481	3E-06	0.000139	SL/G	0.00000527	No-R	0.000144	9E-06
Dry Flowable, Manually-pressurized Handwand, Broadcast	Greenhouse (ornamentals, roses, cut flowers, container stock, vegetables)	0.00000133	SL/G	0.00000122	No-R	0.00000254	2E-07	0.00000398	SL/G	0.00000365	No-R	0.00000763	5E-07
Dry Flowable, Manually-pressurized Handwand, Broadcast (foliar)	Nursery (ornamentals, vegetables, trees, container stock)	0.000000655	SL/G	0.000000597	No-R	0.00000125	8E-08	0.00000197	SL/G	0.00000179	No-R	0.00000376	2E-07
Dry Flowable, Mechanically-pressurized Handgun, Broadcast (foliar)	Orchard/Vineyard	0.000907	SL/G	0.000064	No-R	0.000971	6E-05	0.00272	SL/G	0.000192	No-R	0.00291	2E-04
Dry Flowable, Mechanically-pressurized Handgun, Broadcast	Greenhouse (ornamentals, roses, cut flowers, container stock, vegetables)	0.000064	SL/G	0.000133	No-R	0.000197	1E-05	0.000192	SL/G	0.000398	No-R	0.00059	4E-05

Exposure Scenario	Crop or Target	Private Handler						Commercial Handler					
		LADD (mg/kg/day)				Total LADD <sup>3</sup>	Cancer Risk Estimate <sup>4</sup>	LADD (mg/kg/day)				Total LADD <sup>3</sup>	Cancer Risk Estimate <sup>4</sup>
		Dermal <sup>1</sup>	PPE	Inhalation <sup>2</sup>	PPE			Dermal <sup>1</sup>	PPE	Inhalation <sup>2</sup>	PPE		
Dry Flowable, Mechanically-pressurized Handgun, Broadcast	Golf course (fairways, tees, greens)	0.0000258	SL/G	0.0000129	No-R	0.0000387	2E-06	0.0000774	SL/G	0.0000387	No-R	0.000116	7E-06
Dry Flowable, Mechanically-pressurized Handgun, Broadcast (foliar)	Nursery (ornamentals, vegetables, trees, container stock)	0.00011	SL/G	0.000227	No-R	0.000337	2E-05	0.000329	SL/G	0.000682	No-R	0.00101	6E-05
Dry Flowable, Mechanically-pressurized Handgun, Broadcast (foliar)	Field crop, typical	0.00907	SL/G	0.00064	No-R	0.00971	6E-04	0.0272	SL/G	0.00192	No-R	0.0291	2E-03
Liquid, Backpack, Broadcast	Greenhouse (ornamentals, roses, cut flowers, container stock, vegetables)	0.00000868	SL/G	0.00000182	No-R	0.0000105	6E-07	0.000026	SL/G	0.00000546	No-R	0.0000315	2E-06
Liquid, Backpack, Broadcast (foliar)	Nursery (ornamentals, vegetables, trees, container stock)	0.0000506	SL/G	0.00000191	No-R	0.0000526	3E-06	0.000152	SL/G	0.00000572	No-R	0.000158	1E-05
Liquid, Manually-pressurized Handwand, Broadcast	Greenhouse (ornamentals, roses, cut flowers, container stock, vegetables)	0.000000333	SL/G	0.000000305	No-R	0.000000638	4E-08	0.000000999	SL/G	0.000000915	No-R	0.00000191	1E-07
Liquid, Manually-pressurized Handwand, Broadcast (foliar)	Nursery (ornamentals, vegetables, trees, container stock)	0.000000714	SL/G	0.000000653	No-R	0.00000136	8E-08	0.00000214	SL/G	0.00000196	No-R	0.00000409	2E-07
Liquid, Mechanically-pressurized Handgun, Broadcast (foliar)	Orchard/Vineyard	0.00907	SL/G	0.00064	No-R	0.00971	6E-04	0.0272	SL/G	0.00192	No-R	0.0291	2E-03

Exposure Scenario	Crop or Target	Private Handler						Commercial Handler					
		LADD (mg/kg/day)				Total LADD <sup>3</sup>	Cancer Risk Estimate <sup>4</sup>	LADD (mg/kg/day)				Total LADD <sup>3</sup>	Cancer Risk Estimate <sup>4</sup>
		Dermal <sup>1</sup>	PPE	Inhalation <sup>2</sup>	PPE			Dermal <sup>1</sup>	PPE	Inhalation <sup>2</sup>	PPE		
Liquid, Mechanically-pressurized Handgun, Broadcast	Greenhouse (ornamentals, roses, cut flowers, container stock, vegetables)	0.00007	SL/G	0.000145	No-R	0.000215	1E-05	0.00021	SL/G	0.000435	No-R	0.000645	4E-05
Liquid, Mechanically-pressurized Handgun, Broadcast	Golf course (fairways, tees, greens)	0.000707	SL/G	0.0000253	No-R	0.000733	4E-05	0.00212	SL/G	0.000076	No-R	0.0022	1E-04
Liquid, Mechanically-pressurized Handgun, Broadcast (foliar)	Nursery (ornamentals, vegetables, trees, container stock)	0.00012	SL/G	0.000247	No-R	0.000368	2E-05	0.00036	SL/G	0.000741	No-R	0.0011	7E-05
Liquid, Mechanically-pressurized Handgun, Broadcast (foliar)	Field crop, typical	0.00907	SL/G	0.00064	No-R	0.00971	6E-04	0.0272	SL/G	0.00192	No-R	0.0291	2E-03
Wettable Powder, Backpack, Broadcast	Greenhouse (ornamentals, roses, cut flowers, container stock, vegetables)	0.0000115	SL/G	0.00000241	No-R	0.0000139	8E-07	0.0000346	SL/G	0.00000723	No-R	0.0000417	3E-06
Wettable Powder, Backpack, Broadcast (foliar)	Nursery (ornamentals, vegetables, trees, container stock)	0.0000675	SL/G	0.00000256	No-R	0.0000701	4E-06	0.000202	SL/G	0.00000767	No-R	0.00021	1E-05
Wettable Powder, Manually-pressurized Handwand, Broadcast	Greenhouse (ornamentals, roses, cut flowers, container stock, vegetables)	0.000146	SL/G	0.000000761	No-R	0.000148	9E-06	0.000439	SL/G	0.00000228	No-R	0.000443	3E-05

Exposure Scenario	Crop or Target	Private Handler						Commercial Handler					
		LADD (mg/kg/day)				Total LADD <sup>3</sup>	Cancer Risk Estimate <sup>4</sup>	LADD (mg/kg/day)				Total LADD <sup>3</sup>	Cancer Risk Estimate <sup>4</sup>
		Dermal <sup>1</sup>	PPE	Inhalation <sup>2</sup>	PPE			Dermal <sup>1</sup>	PPE	Inhalation <sup>2</sup>	PPE		
Wettable Powder, Manually-pressurized Handwand, Broadcast (foliar)	Nursery (ornamentals, vegetables, trees, container stock)	0.000000445	SL/G	0.000000406	No-R	0.000000851	5E-08	0.00000134	SL/G	0.00000122	No-R	0.00000255	2E-07
Wettable Powder, Mechanically-pressurized Handgun, Broadcast (foliar)	Orchard/Vineyard	0.00000762	SL/G	0.00000696	No-R	0.0000146	9E-07	0.0000229	SL/G	0.0000209	No-R	0.0000439	3E-06
Wettable Powder, Mechanically-pressurized Handgun, Broadcast	Greenhouse (ornamentals, roses, cut flowers, container stock, vegetables)	0.00182	SL/G	0.000128	No-R	0.00194	1E-04	0.00546	SL/G	0.000384	No-R	0.00583	4E-04
Wettable Powder, Mechanically-pressurized Handgun, Broadcast (foliar)	Nursery (ornamentals, vegetables, trees, container stock)	0.0000932	SL/G	0.000192	No-R	0.000285	2E-05	0.00028	SL/G	0.000575	No-R	0.000856	5E-05
Wettable Powder, Mechanically-pressurized Handgun, Broadcast (foliar)	Field crop, typical	0.000302	SL/G	0.0000214	No-R	0.000323	2E-05	0.000907	SL/G	0.0000642	No-R	0.00097	6E-05
Water-soluble Packet, Backpack, Broadcast	Greenhouse (ornamentals, roses, cut flowers, container stock, vegetables)	0.00907	SL/G	0.00064	No-R	0.00971	6E-04	0.0272	SL/G	0.00192	No-R	0.0291	2E-03
Water-soluble Packet, Backpack, Broadcast (foliar)	Nursery (ornamentals, vegetables, trees, container stock)	0.0000152	SL/G	0.00000317	No-R	0.0000184	1E-06	0.0000457	SL/G	0.00000952	No-R	0.0000553	3E-06

Exposure Scenario	Crop or Target	Private Handler						Commercial Handler					
		LADD (mg/kg/day)				Total LADD <sup>3</sup>	Cancer Risk Estimate <sup>4</sup>	LADD (mg/kg/day)				Total LADD <sup>3</sup>	Cancer Risk Estimate <sup>4</sup>
		Dermal <sup>1</sup>	PPE	Inhalation <sup>2</sup>	PPE			Dermal <sup>1</sup>	PPE	Inhalation <sup>2</sup>	PPE		
Water-soluble Packet, Manually-pressurized Handwand, Broadcast	Greenhouse (ornamentals, roses, cut flowers, container stock, vegetables)	0.000541	SL/G	0.0000204	No-R	0.000562	3E-05	0.00162	SL/G	0.0000612	No-R	0.00169	1E-04
Water-soluble Packet, Manually-pressurized Handwand, Broadcast (foliar)	Nursery (ornamentals, vegetables, trees, container stock)	0.000146	SL/G	0.000000761	No-R	0.000148	9E-06	0.000439	SL/G	0.00000228	No-R	0.000443	3E-05
Water-soluble Packet, Mechanically-pressurized Handgun, Broadcast	Greenhouse (ornamentals, roses, cut flowers, container stock, vegetables)	0.00000301	SL/G	0.00000275	No-R	0.00000577	3E-07	0.00000904	SL/G	0.00000826	No-R	0.0000173	1E-06
Water-soluble Packet, Mechanically-pressurized Handgun, Broadcast	Golf course (fairways, tees, greens)	0.00000762	SL/G	0.00000696	No-R	0.0000146	9E-07	0.0000229	SL/G	0.0000209	No-R	0.0000439	3E-06
Water-soluble Packet, Mechanically-pressurized Handgun, Broadcast (foliar)	Nursery (ornamentals, vegetables, trees, container stock)	0.000123	SL/G	0.000253	No-R	0.000376	2E-05	0.000368	SL/G	0.00076	No-R	0.00113	7E-05

- 1 Dermal LADD (mg/kg/day) = Total Dermal dose (mg/kg/day) × [Days per year of exposure (days/yr) ÷ 365 days/year] × [Years per lifetime of exposure (35 yrs) ÷ Lifetime expectancy (78 yrs)].

Total Dermal Dose = ETU Dermal Dose (mg/kg/day) + Metabolized ETU Dermal Dose (mg/kg/day)

ETU Dermal Dose = Dermal Unit Exposure (µg/lb ai) × Conversion Factor (0.001 mg/µg) × [Tank Mix Conversion (0.001 for mixer/loader) or (0.002 for applicator or M/L/A)]\* × Application Rate (lb ai/acre or gal) × Area Treated or Amount Handled (A or gal/day) × DAF (6%) ÷ BW (80 kg).

Metabolized ETU Dermal Dose = Dermal Unit Exposure (µg/lb ai) × Conversion Factor (0.001 mg/µg) × Metabolic Conversion Factor (7.5%)\* × Application Rate (lb ai/acre or gal) × Area Treated or Amount Handled (A or gal/day) × DAF (1%) ÷ BW (80 kg).
- 2 Inhalation LADD (mg/kg/day) = Total Inhalation Dose (mg/kg/day) × [Days per year of exposure (days/yr) / 365 days/year] × [Years per lifetime of exposure (35 yrs) ÷ Lifetime expectancy (78 yrs)].

Total Inhalation Dose = ETU Inhalation dose (mg/kg/day) + Metabolized ETU Inhalation Dose (mg/kg/day)

ETU Inhalation Dose = Inhalation Unit Exposure (µg/lb ai) × Conversion Factor (0.001 mg/µg) × [Tank Mix Conversion (0.001 for mixer/loader) or (0.002 for applicator or M/L/A)]\* × Application Rate (lb ai/acre or gal) × Area Treated or Amount Handled (A or gal/day) ÷ BW (80 kg).

Metabolized ETU Dose = Inhalation Unit Exposure (µg/lb ai) × Conversion Factor (0.001 mg/µg) × Metabolic Conversion Factor (7.5%)\* × Application Rate (lb ai/acre or gal) × Area Treated or Amount Handled (A or gal/day) ÷ BW (80 kg).

3 Total LADD (mg/kg/day) = Dermal LADD (mg/kg/day) + Inhalation LADD (mg/kg/day).

4 Cancer risk estimate = LADD (mg/kg/day) × Q<sub>1</sub><sup>\*</sup>, where Q<sub>1</sub><sup>\*</sup> = 0.0601 (mg/kg/day)<sup>-1</sup>.

\* See section 4.0 for further details.

Table F-6. Occupational Handler Cancer Exposure and Risk Estimates for ETU – Seed Treatment.							
Crop/Target Category	Specialized Treatment or Formulation	Worker Activity	Application Rate (lb ai/lb seed) <sup>1</sup>	Combined MOE <sup>3,4,5</sup> (LOC = 300)			
				SL/G + No-R	DL/G + No-R	SL/G + PF10	DL/G + PF10
<b>Commercial Seed Treatment</b>							
Barley	NA	Treating	0.0315	1E-04	9E-05	2E-05	1E-05
		Packaging		5E-05	5E-05	1E-05	1E-05
		Cleaning		1E-04	1E-04	4E-05	4E-05
		Loading/Planting		8E-05	7E-05	2E-05	2E-05
Corn, field	NA	Treating	0.0405	4E-05	4E-05	2E-05	2E-05
		Packaging		2E-05	2E-05	2E-05	1E-05
		Cleaning		5E-05	4E-05	6E-05	5E-05
		Loading/Planting		8E-05	8E-05	8E-06	6E-06
Cotton	NA	Treating	0.045	3E-05	3E-05	8E-06	7E-06
		Packaging		2E-05	2E-05	6E-06	6E-06
		Cleaning		5E-05	5E-05	6E-05	6E-05
		Loading/Planting		1E-04	9E-05	5E-06	4E-06
Flax	NA	Treating	0.0533	3E-05	3E-05	9E-06	8E-06
		Packaging		6E-05	6E-05	8E-06	7E-06
		Cleaning		1E-04	1E-04	7E-05	7E-05
		Loading/Planting		9E-05	8E-05	7E-06	6E-06
Oat	NA	Treating	0.0473	1E-04	1E-04	2E-05	2E-05
		Packaging		6E-05	5E-05	2E-05	2E-05
		Cleaning		1E-04	1E-04	6E-05	6E-05
		Loading/Planting		2E-04	2E-04	3E-05	2E-05
Peanut	NA	Treating	0.12	3E-04	3E-04	2E-05	2E-05
		Packaging		2E-06	2E-06	2E-05	2E-05
		Cleaning		5E-06	5E-06	2E-04	2E-04
		Loading/Planting		1E-06	1E-06	7E-05	6E-05
Potato	NA	Treating	0.0008	5E-05	5E-05	9E-07	8E-07
		Packaging		4E-05	3E-05	7E-07	7E-07
		Cleaning		8E-05	8E-05	1E-06	1E-06
		Loading/Planting		6E-05	6E-05	1E-05	9E-06
Rice	NA	Treating	0.032	2E-04	2E-04	1E-05	1E-05
		Packaging		4E-05	3E-05	1E-05	1E-05
		Cleaning		8E-05	8E-05	4E-05	4E-05
		Loading/Planting		5E-05	5E-05	3E-05	3E-05
Rye	NA	Treating	0.027	8E-05	7E-05	1E-05	1E-05
		Packaging		2E-05	2E-05	1E-05	1E-05
		Cleaning		4E-05	4E-05	4E-05	3E-05
		Loading/Planting		3E-05	3E-05	2E-05	1E-05

Table F-6. Occupational Handler Cancer Exposure and Risk Estimates for ETU – Seed Treatment.							
Crop/Target Category	Specialized Treatment or Formulation	Worker Activity	Application Rate (lb ai/lb seed) <sup>1</sup>	Combined MOE <sup>3,4,5</sup> (LOC = 300)			
				SL/G + No-R	DL/G + No-R	SL/G + PF10	DL/G + PF10
Safflower	NA	Treating	0.015	7E-06	6E-06	8E-06	6E-06
		Packaging		4E-05	4E-05	6E-06	6E-06
		Cleaning		1E-04	1E-04	2E-05	2E-05
		Loading/Planting		6E-05	6E-05	1E-06	1E-06
Sorghum, grain	NA	Treating	0.0338	5E-06	5E-06	2E-05	1E-05
		Packaging		7E-07	6E-07	1E-05	1E-05
		Cleaning		1E-06	1E-06	5E-05	4E-05
		Loading/Planting		1E-04	1E-04	1E-06	8E-07
Tomato	Film-coated	Treating	0.06	8E-07	8E-07	3E-07	2E-07
	Film-coated	Packaging		5E-08	5E-08	2E-07	2E-07
	Film-coated	Cleaning		1E-07	1E-07	8E-05	8E-05
	Film-coated	Loading/Planting		1E-04	1E-04	2E-07	1E-07
	Encrusted/Pelleted	Treating		8E-07	8E-07	2E-08	2E-08
	Encrusted/Pelleted	Packaging		3E-05	3E-05	2E-08	1E-08
	Encrusted/Pelleted	Cleaning		7E-05	7E-05	8E-05	8E-05
	Encrusted/Pelleted	Loading/Planting		5E-05	4E-05	2E-07	1E-07
Triticale	NA	Treating	0.0248	8E-05	8E-05	1E-05	1E-05
		Packaging		3E-05	3E-05	1E-05	9E-06
		Cleaning		7E-05	7E-05	3E-05	3E-05
		Loading/Planting		5E-05	4E-05	2E-05	1E-05
Wheat	NA	Treating	0.0248	1E-04	1E-04	1E-05	1E-05
		Packaging		1E-04	9E-05	1E-05	9E-06
		Cleaning		5E-05	5E-05	3E-05	3E-05
		Loading/Planting		1E-04	1E-04	2E-05	2E-05
<b>On-Farm Seed Treatment</b>							
Barley	Liquid	Treating/Planting	0.00209	3E-06	3E-06	5E-07	5E-07
	Dust/Powder [Solids]		0.00131	4E-05	4E-05	8E-06	7E-06
Corn, field	Liquid		0.00209	1E-06	1E-06	2E-07	2E-07
Cotton	Liquid		0.003	1E-06	9E-07	2E-07	1E-07
Flax	Liquid		0.003	1E-06	1E-06	2E-07	1E-07
Oat	Liquid		0.00313	5E-06	5E-06	8E-07	7E-07
	Dust/Powder [Solids]		0.00197	5E-05	5E-05	1E-05	1E-05
Peanut	Liquid		0.008	1E-05	1E-05	2E-06	2E-06
Potato	Liquid		0.000781	3E-05	3E-05	4E-06	4E-06
	Dust/Powder [Solids]		0.0008	5E-04	5E-04	1E-04	9E-05
Rice	Liquid		0.002	5E-06	5E-06	8E-07	8E-07
	Dust/Powder [Solids]		0.00125	6E-05	6E-05	1E-05	1E-05

Table F-6. Occupational Handler Cancer Exposure and Risk Estimates for ETU – Seed Treatment.							
Crop/Target Category	Specialized Treatment or Formulation	Worker Activity	Application Rate (lb ai/lb seed) <sup>1</sup>	Combined MOE <sup>3,4,5</sup> (LOC = 300)			
				SL/G + No-R	DL/G + No-R	SL/G + PF10	DL/G + PF10
Rye	Liquid		0.00178	3E-06	3E-06	4E-07	4E-07
	Dust/Powder [Solids]		0.00113	3E-05	3E-05	6E-06	5E-06
Safflower	Liquid		0.001	2E-07	2E-07	4E-08	3E-08
	Dust/Powder [Solids]		0.00094	4E-06	4E-06	8E-07	7E-07
Sorghum, grain	Liquid		0.00225	2E-07	2E-07	3E-08	3E-08
	Dust/Powder [Solids]		0.00094	1E-06	1E-06	3E-07	2E-07
Tomato	Liquid		0.004	3E-08	3E-08	5E-09	4E-09
Triticale	Liquid		0.00163	3E-06	3E-06	5E-07	4E-07
	Dust/Powder [Solids]		0.00103	3E-05	3E-05	7E-06	6E-06
Wheat	Liquid		0.00163	4E-06	4E-06	7E-07	6E-07
	Dust/Powder [Solids]		0.00103	5E-05	5E-05	1E-05	9E-06

<sup>1</sup> Seed Treatment Application rates based on the registered mancozeb labels. See Appendix D.

<sup>2</sup> HED default for lb seed treated/planted per day from HED Exposure Science Advisory Council Policy 15.

<sup>3</sup> Unit Exposures from HED Exposure Science Advisory Council Policy 14: Standard Operating Procedures for Seed Treatment.

<sup>4</sup> PPE: SL/G = Single Layer/Gloves, DL/G = Double Layer/Gloves, No-R = No Respirator, and PF10 R = PF10 Respirator

<sup>5</sup> Cancer risk estimate = Combined Average LADD (mg/kg/day) × Q<sub>1</sub><sup>\*</sup>, where Q<sub>1</sub><sup>\*</sup> = 0.0601 (mg/kg/day)<sup>-1</sup>.

Table F-7. Occupational Post-Application Non-Cancer and Cancer Risk Summary for ETU. <sup>1</sup>								
Crop	Crop Height	Foliage Density	Application Rate (lb ai/A)	Activity	Transfer Coefficient (cm <sup>2</sup> /hr or gm/hr)	Non-Cancer		Cancer
						Dermal MOE <sup>2,3</sup> (LOC = 300)	DAT at which MOE ≥ LOC [MOE]	Cancer Risk Estimate
						0-DAT		30-day Average Dose
<b>WA Apple DFR Data (MRID 44959602)</b>								
Almond	High	Full	4.8	Orchard maintenance	100	1600		2E-07
	High	Full		Harvesting, Mechanical (shaking)	190	850		3E-07
	High	Full		Scouting	580	280	3 [300]	1E-06
	High	Full		Poling	100	1600		2E-07
Apple	Low	Min	4.8	Transplanting	230	700		4E-07
	HIGH	FULL		Scouting	580	280	3 [300]	1E-06
	HIGH	FULL		Weeding, Hand	100	1600		2E-07
	HIGH	FULL		Harvesting, Hand	1400	110	32 [300]	3E-06
	HIGH	FULL		Propping	100	1600		2E-07
	HIGH	FULL		Orchard maintenance	100	1600		2E-07
	HIGH	FULL		Pruning, Hand	580	280	3 [300]	1E-06
	HIGH	FULL		Training	580	280	3 [300]	1E-06
	LOW	MIN		Transplanting	230	700		4E-07
	LOW	MIN		Pruning, Hand	580	280	3 [300]	1E-06
	LOW	FULL		Weeding, Hand	100	1600		2E-07
	Christmas Tree	HIGH		FULL	3.2	Thinning Fruit, Hand	3600	45
HIGH		FULL	Irrigation (hand set)	1900		130	29 [300]	2E-06
LOW		FULL	Irrigation (hand set)	1900		130	29 [300]	2E-06
HIGH		FULL	Scouting	580		420		7E-07
HIGH		FULL	Weeding, Hand	100		2400		1E-07
HIGH		FULL	Harvesting, Hand	1400		170	18 [300]	2E-06
HIGH		FULL	Grading/Tagging	100		2400		1E-07
LOW		MIN	Weeding, Hand	100		2400		1E-07
LOW		MIN	Transplanting	230		1000		3E-07
LOW		MIN	Scouting	580		420		7E-07
LOW		MIN	Shaping	580		420		7E-07
Mango	HIGH	FULL	2.0	Grading/Tagging	100	2400		1E-07
	HIGH	FULL		Harvesting, Hand	1400	280	3 [300]	1E-06
	HIGH	FULL		Thinning Fruit, Hand	3600	110	34 [300]	3E-06
	HIGH	FULL		Pruning, Hand	580	660		4E-07
Papaya	HIGH	FULL	2.0	Scouting	580	660		4E-07
	HIGH	FULL		Orchard maintenance	100	3900		8E-08
	HIGH	FULL		Scouting	580	660		4E-07
	HIGH	FULL		Weeding, Hand	100	3900		8E-08
	HIGH	FULL		Harvesting, Hand	1400	280	3 [300]	1E-06
	HIGH	FULL		Pruning, Hand	580	660		4E-07
	LOW	MIN		Transplanting	230	1700		2E-07
HIGH	MIN	Pruning, Hand	580	660		4E-07		

Table F-7. Occupational Post-Application Non-Cancer and Cancer Risk Summary for ETU. <sup>1</sup>								
Crop	Crop Height	Foliage Density	Application Rate (lb ai/A)	Activity	Transfer Coefficient (cm <sup>2</sup> /hr or gm/hr)	Non-Cancer		Cancer
						Dermal MOE <sup>2,3</sup> (LOC = 300)	DAT at which MOE ≥ LOC [MOE]	Cancer Risk Estimate
								0-DAT
Walnut, English	HIGH	FULL	1.8	Harvesting, Mechanical (shaking)	190	2300		1E-07
	HIGH	FULL		Orchard maintenance	100	4300		7E-08
	HIGH	FULL		Poling	100	4300		7E-08
	HIGH	FULL		Scouting	580	740		4E-07
	HIGH	FULL		Weeding, Hand	100	4300		7E-08
	LOW	MIN		Transplanting	230	1900		2E-07
<b>NY Apple DFR Data (MRID 44959602)</b>								
Almond	High	Full	4.8	Orchard maintenance	100	1300		1E-07
	High	Full		Harvesting, Mechanical (shaking)	190	700		2E-07
	High	Full		Scouting	580	230	4 [320]	7E-07
	High	Full		Poling	100	1300		1E-07
	Low	Min		Transplanting	230	580		3E-07
Apple	HIGH	FULL	4.8	Scouting	580	230	4 [320]	7E-07
	HIGH	FULL		Weeding, Hand	100	1300		1E-07
	HIGH	FULL		Harvesting, Hand	1400	95	15 [310]	2E-06
	HIGH	FULL		Propping	100	1300		1E-07
	HIGH	FULL		Orchard maintenance	100	1300		1E-07
	HIGH	FULL		Pruning, Hand	580	230	4 [320]	7E-07
	HIGH	FULL		Training	580	230	4 [320]	7E-07
	LOW	MIN		Transplanting	230	580		3E-07
	LOW	MIN		Pruning, Hand	580	230	4 [320]	7E-07
	LOW	FULL		Weeding, Hand	100	1300		1E-07
	HIGH	FULL		Thinning Fruit, Hand	3600	37	27 [310]	5E-06
Christmas Tree	HIGH	FULL	3.2	Irrigation (hand set)	1900	110	13 [300]	2E-06
	LOW	FULL		Irrigation (hand set)	1900	110	13 [300]	2E-06
	HIGH	FULL		Scouting	580	350		5E-07
	HIGH	FULL		Weeding, Hand	100	2000		9E-08
	HIGH	FULL		Harvesting, Hand	1400	140	10 [320]	1E-06
	HIGH	FULL		Grading/Tagging	100	2000		9E-08
	LOW	MIN		Weeding, Hand	100	2000		9E-08
	LOW	MIN		Transplanting	230	870		2E-07
	LOW	MIN		Scouting	580	350		5E-07
	HIGH	FULL		Shaping	580	350		5E-07
	LOW	MIN		Grading/Tagging	100	2000		9E-08
Mango	HIGH	FULL	2.0	Harvesting, Hand	1400	230	4 [310]	7E-07
	HIGH	FULL		Thinning Fruit, Hand	3600	89	16 [320]	2E-06
	HIGH	FULL		Pruning, Hand	580	550		3E-07
	HIGH	FULL		Scouting	580	550		3E-07

Table F-7. Occupational Post-Application Non-Cancer and Cancer Risk Summary for ETU. <sup>1</sup>								
Crop	Crop Height	Foliage Density	Application Rate (lb ai/A)	Activity	Transfer Coefficient (cm <sup>2</sup> /hr or gm/hr)	Non-Cancer		Cancer
						Dermal MOE <sup>2,3</sup> (LOC = 300)	DAT at which MOE ≥ LOC [MOE]	Cancer Risk Estimate
						0-DAT		30-day Average Dose
Papaya	HIGH	FULL	2.0	Orchard maintenance	100	3200		5E-08
	HIGH	FULL		Scouting	580	550		3E-07
	HIGH	FULL		Weeding, Hand	100	3200		5E-08
	HIGH	FULL		Harvesting, Hand	1400	230	4 [310]	7E-07
	HIGH	FULL		Pruning, Hand	580	550		3E-07
	LOW	MIN		Transplanting	230	1400		1E-07
	HIGH	MIN		Pruning, Hand	580	550		3E-07
Walnut, English	HIGH	FULL	1.8	Harvesting, Mechanical (shaking)	190	1900		9E-08
	HIGH	FULL		Orchard maintenance	100	3600		5E-08
	HIGH	FULL		Poling	100	3600		5E-08
	HIGH	FULL		Scouting	580	610		3E-07
	HIGH	FULL		Weeding, Hand	100	3600		5E-08
	LOW	MIN		Transplanting	230	1500		1E-07
<b>Grape DFR Data (MRID 44959601)</b>								
Grape, Table	HIGH	FULL	3.2	Girdling	19300	16	>30 [56]	2E-05
	HIGH	FULL		Irrigation (hand set)	1900	160	15 [300]	2E-06
	HIGH	FULL		Scouting	640	470		5E-07
	HIGH	FULL		Turning	19300	16	>30 [56]	2E-05
	HIGH	FULL		Tying/Training	5500	55	>30 [190]	5E-06
	HIGH	FULL		Harvesting, Hand	5500	55	>30 [190]	5E-06
	HIGH	FULL		Pruning, Hand	640	470		5E-07
	HIGH	FULL		Leaf Pulling	5500	55	>30 [190]	5E-06
	HIGH	FULL		Weeding, Hand	640	470		5E-07
	LOW	MIN		Tying/Training	5500	55	>30 [190]	5E-06
	LOW	MIN		Transplanting	230	1300		2E-07
Grape, Raisin	HIGH	FULL	3.2	Irrigation (hand set)	1900	160	>30 [190]	2E-06
	HIGH	FULL		Scouting	640	470		5E-07
	HIGH	FULL		Tying/Training	5500	55	>30 [190]	5E-06
	HIGH	FULL		Harvesting, Hand	5500	55	>30 [190]	5E-06
	HIGH	FULL		Pruning, Hand	640	470		5E-07
	HIGH	FULL		Leaf Pulling	5500	55	>30 [190]	5E-06
	HIGH	FULL		Weeding, Hand	640	470		5E-07
	LOW	MIN		Tying/Training	5500	55	>30 [190]	5E-06
	LOW	MIN		Transplanting	230	1300		2E-07
Grape, Wine/Juice	HIGH	FULL	3.2	Scouting	640	470		5E-07
	HIGH	FULL		Pruning, Hand	640	470		5E-07
	HIGH	FULL		Irrigation (hand set)	1900	160	15 [300]	2E-06
	HIGH	FULL		Weeding, Hand	640	470		5E-07
	HIGH	MIN						
	LOW	MIN		Scouting	640	470		5E-07

Table F-7. Occupational Post-Application Non-Cancer and Cancer Risk Summary for ETU. <sup>1</sup>								
Crop	Crop Height	Foliage Density	Application Rate (lb ai/A)	Activity	Transfer Coefficient (cm <sup>2</sup> /hr or gm/hr)	Non-Cancer		Cancer
						Dermal MOE <sup>2,3</sup> (LOC = 300)	DAT at which MOE ≥ LOC [MOE]	Cancer Risk Estimate
						0-DAT		30-day Average Dose
	LOW	MIN		Propagating	640	470		5E-07
	LOW	MIN		Transplanting	230	1300		2E-07
	HIGH	FULL		Bird Control	640	470		5E-07
	LOW	MIN		Trellis Repair	640	470		5E-07
<b>Field Tomato DFR Data (MRID 44959603)</b>								
Asparagus	HIGH	FULL	1.6	Weeding, Hand	70	8800		1E-08
	HIGH	FULL		Irrigation (hand set)	1900	320		4E-07
	HIGH	FULL		Scouting	210	2900		4E-08
	LOW	MIN		Irrigation (hand set)	1900	320		4E-07
	LOW	MIN		Weeding, Hand	70	8800		1E-08
	LOW	MIN		Scouting	210	2900		4E-08
	LOW	MIN		Harvesting, Hand	1100	560		2E-07
	LOW	MIN		Transplanting	230	2700		5E-08
	LOW	FULL		Irrigation (hand set)	1900	320		4E-07
	LOW	FULL		Scouting	210	2900		4E-08
Banana	HIGH	FULL	2.4	Weeding, Hand	70	8800		1E-08
	LOW	FULL		Weeding, Hand	100	4100		3E-08
	HIGH	FULL		Harvesting, Hand	1400	290	1 [330]	4E-07
Barley	LOW	FULL	1.6	Scouting	1100	560		2E-07
	LOW	MIN		Scouting	1100	560		2E-07
Beet, sugar	LOW	FULL	1.6	Scouting	210	2900		4E-08
	LOW	FULL		Weeding, Hand	70	8800		1E-08
	LOW	MIN		Scouting	210	2900		4E-08
	LOW	MIN		Thinning Plants, Hand	70	8800		1E-08
	LOW	MIN		Weeding, Hand	70	8800		1E-08
Beet, garden	LOW	FULL	1.5	Harvesting, Hand	1100	600		2E-07
	LOW	FULL		Irrigation (hand set)	1900	350		4E-07
	LOW	FULL		Scouting	210	3100		4E-08
	LOW	FULL		Weeding, Hand	70	9400		1E-08
	LOW	FULL		Irrigation (hand set)	1900	350		4E-07
	LOW	MIN		Scouting	210	3100		4E-08
	LOW	MIN		Thinning Plants, Hand	70	9400		1E-08
	LOW	MIN		Weeding, Hand	70	9400		1E-08
Broccoli	LOW	FULL	1.6	Scouting	4200	150	6 [310]	8E-07
	LOW	FULL		Harvesting, Hand	4200	150	6 [310]	8E-07
	LOW	FULL		Irrigation (hand set)	1900	320		4E-07
	LOW	FULL		Weeding, Hand	4200	150	6 [310]	8E-07
	LOW	MIN		Scouting	330	1900		7E-08
	LOW	MIN		Thinning Plants, Hand	330	1900		7E-08

Crop	Crop Height	Foliage Density	Application Rate (lb ai/A)	Activity	Transfer Coefficient (cm <sup>2</sup> /hr or gm/hr)	Non-Cancer		Cancer		
						Dermal MOE <sup>2,3</sup> (LOC = 300)	DAT at which MOE ≥ LOC [MOE]	Cancer Risk Estimate		
						0-DAT		30-day Average Dose		
	LOW	MIN		Irrigation (hand set)	1900	320		4E-07		
	LOW	MIN		Transplanting	230	2700		5E-08		
	LOW	MIN		Weeding, Hand	1400	440		3E-07		
Cabbage	LOW	FULL	1.6	Scouting	1400	440		3E-07		
	LOW	FULL		Harvesting, Hand	1400	440		3E-07		
	LOW	FULL		Irrigation (hand set)	1900	320		4E-07		
	LOW	FULL		Weeding, Hand	4200	150	6 [310]	8E-07		
	LOW	FULL		Harvesting, Mechanically-assisted	1400	440		3E-07		
	LOW	MIN		Scouting	330	1900		7E-08		
	LOW	MIN		Thinning Plants, Hand	330	1900		7E-08		
	LOW	MIN		Weeding, Hand	1400	440		3E-07		
	LOW	MIN		Irrigation (hand set)	1900	320		4E-07		
	LOW	MIN		Transplanting	230	2700		5E-08		
	Carrot	LOW		FULL	1.5	Harvesting, Hand	1100	600		2E-07
		LOW		FULL		Irrigation (hand set)	1900	350		4E-07
LOW		FULL	Scouting	210		3100		4E-08		
LOW		FULL	Weeding, Hand	70		9400		1E-08		
LOW		MIN	Irrigation (hand set)	1900		350		4E-07		
LOW		MIN	Scouting	210		3100		4E-08		
LOW		MIN	Weeding, Hand	70		9400		1E-08		
Corn, field	HIGH	FULL	1.2	Irrigation (hand set)	1900	430		3E-07		
	HIGH	FULL		Scouting	1100	750		2E-07		
	LOW	MIN		Scouting	210	3900		3E-08		
	LOW	MIN		Irrigation (hand set)	1900	430		3E-07		
	LOW	FULL		Irrigation (hand set)	1900	430		3E-07		
	LOW	FULL		Scouting	210	3900		3E-08		
	LOW	MIN		Weeding, Hand	70	12000		1E-08		
	LOW	FULL		Weeding, Hand	70	12000		1E-08		
Corn, pop	HIGH	FULL	1.2	Irrigation (hand set)	1900	430		3E-07		
	HIGH	FULL		Scouting	1100	750		2E-07		
	LOW	MIN		Scouting	210	3900		3E-08		
	LOW	MIN		Irrigation (hand set)	1900	430		3E-07		
	LOW	FULL		Irrigation (hand set)	1900	430		3E-07		
	LOW	FULL		Scouting	210	3900		3E-08		
	LOW	MIN		Weeding, Hand	70	12000		1E-08		
	LOW	FULL		Weeding, Hand	70	12000		1E-08		
Corn, sweet, grain	HIGH	FULL	1.2	Irrigation (hand set)	1900	430		3E-07		
	HIGH	FULL		Scouting	1100	750		2E-07		
	LOW	FULL		Scouting	210	3900		3E-08		
	HIGH	FULL		Harvesting, Hand	8800	93	10 [320]	1E-06		

Crop	Crop Height	Foliage Density	Application Rate (lb ai/A)	Activity	Transfer Coefficient (cm <sup>2</sup> /hr or gm/hr)	Non-Cancer		Cancer
						Dermal MOE <sup>2,3</sup> (LOC = 300)	DAT at which MOE ≥ LOC [MOE]	Cancer Risk Estimate
								0-DAT
	LOW	MIN		Weeding, Hand	70	12000		1E-08
	LOW	MIN		Scouting	210	3900		3E-08
	LOW	MIN		Irrigation (hand set)	1900	430		3E-07
	LOW	FULL		Weeding, Hand	70	12000		3E-07
Cranberry	LOW	FULL	4.8	Harvesting, Hand (raking)	1100	190	4 [310]	7E-07
	LOW	FULL		Pruning, Hand (shears)	70	2900		4E-08
	LOW	FULL		Scouting	1100	190	4 [310]	7E-07
	LOW	FULL		Weeding, Hand	70	2900		4E-08
Cucumber	LOW	MIN	2.4	Transplanting	230	890		1E-07
	LOW	FULL		Irrigation (hand set)	1900	220	3 [320]	6E-07
	LOW	FULL		Scouting	90	4600		3E-08
	LOW	FULL		Weeding, Hand	90	4600		3E-08
	LOW	FULL		Harvesting, Hand	550	750		2E-07
	LOW	FULL		Pruning, Hand	90	4600		3E-08
	LOW	FULL		Thinning Fruit, Hand	90	4600		3E-08
	LOW	FULL		Harvesting, Mechanically-assisted	550	750		2E-07
	LOW	MIN		Scouting	90	4600		3E-08
	LOW	MIN		Thinning Fruit, Hand	90	4600		3E-08
	LOW	MIN		Weeding, Hand	90	4600		3E-08
	LOW	MIN		Transplanting	230	1800		7E-08
	LOW	MIN		Irrigation (hand set)	1900	220	3 [320]	6E-07
	LOW	FULL		Training	550	750		2E-07
Greens, leafy	LOW	FULL	1.5	Irrigation (hand set)	1900	350		4E-07
	LOW	FULL		Scouting	210	3100		4E-08
	LOW	FULL		Harvesting, Hand	1100	600		2E-07
	LOW	MIN		Thinning Plants, Hand	70	9400		1E-08
	LOW	FULL		Weeding, Hand	70	9400		1E-08
	LOW	MIN		Irrigation (hand set)	1900	350		4E-07
	LOW	MIN		Scouting	210	3100		4E-08
	LOW	MIN		Weeding, Hand	70	9400		1E-08
	LOW	MIN		Transplanting	230	2900		4E-08
	LOW	FULL		Irrigation (hand set)	1900	350		4E-07
	LOW	FULL		Scouting	210	3100		4E-08
	LOW	FULL		Harvesting, Hand	1100	600		2E-07
	LOW	MIN		Thinning Plants, Hand	70	9400		1E-08
	LOW	FULL		Weeding, Hand	70	9400		1E-08
	LOW	MIN		Irrigation (hand set)	1900	350		4E-07
	LOW	MIN		Scouting	210	3100		4E-08
	LOW	MIN		Weeding, Hand	70	9400		1E-08
	LOW	MIN		Transplanting	230	2900		4E-08

Crop	Crop Height	Foliage Density	Application Rate (lb ai/A)	Activity	Transfer Coefficient (cm <sup>2</sup> /hr or gm/hr)	Non-Cancer		Cancer
						Dermal MOE <sup>2,3</sup> (LOC = 300)	DAT at which MOE ≥ LOC [MOE]	Cancer Risk Estimate
								0-DAT
Lettuce, leaf	LOW	FULL	1.88	Irrigation (hand set)	1900	280	1 [310]	4E-07
	LOW	FULL		Scouting	210	2500		5E-08
	LOW	FULL		Harvesting, Hand	1100	480		3E-07
	LOW	FULL		Weeding, Hand	70	7500		2E-08
	LOW	MIN		Irrigation (hand set)	1900	280	1 [310]	4E-07
	LOW	MIN		Scouting	210	2500		5E-08
	LOW	MIN		Thinning Plants, Hand	70	7500		2E-08
	LOW	MIN		Weeding, Hand	70	7500		2E-08
	LOW	MIN		Transplanting	230	2300		5E-08
	LOW	FULL		Irrigation (hand set)	1900	280	1 [310]	4E-07
	LOW	FULL		Scouting	210	2500		5E-08
	LOW	FULL		Harvesting, Hand	1100	480		3E-07
	LOW	FULL		Weeding, Hand	70	7500		2E-08
	LOW	MIN		Irrigation (hand set)	1900	280	1 [310]	4E-07
	LOW	MIN		Scouting	210	2500		5E-08
	LOW	MIN		Thinning Plants, Hand	70	7500		2E-08
	LOW	MIN		Weeding, Hand	70	7500		2E-08
	LOW	MIN		Transplanting	230	2300		5E-08
Nursery Crop (Ornamentals, Non-bearing Plants)	HIGH	FULL	1.6	Harvesting, Hand	230	2700		5E-08
	LOW	FULL		Harvesting, Hand	230	2700		5E-08
	HIGH	FULL		Irrigation (hand set)	1900	320		4E-07
	LOW	FULL		Irrigation (hand set)	1900	320		4E-07
	HIGH	FULL		Pruning, Hand	230	2700		5E-08
	LOW	FULL		Pruning, Hand	230	2700		5E-08
	HIGH	FULL		Scouting	230	2700		5E-08
	LOW	FULL		Scouting	230	2700		5E-08
	HIGH	FULL		Container Moving	230	2700		5E-08
	HIGH	FULL		Weeding, Hand	230	2700		5E-08
	LOW	FULL		Weeding, Hand	230	2700		5E-08
	HIGH	FULL		Transplanting	230	2700		5E-08
	LOW	FULL		Transplanting	230	2700		5E-08
	LOW	MIN		Grafting	230	2700		5E-08
	HIGH	MIN		Harvesting, Hand	230	2700		5E-08
	LOW	MIN		Propagating	230	2700		5E-08
	HIGH	MIN		Pruning, Hand	230	2700		5E-08
	HIGH	MIN		Transplanting	230	2700		5E-08
	LOW	MIN		Transplanting	230	2700		5E-08
	LOW	FULL		Pinching	230	2700		5E-08
HIGH	FULL	Pinching	230	2700		5E-08		
LOW	FULL	Tying/Training	230	2700		5E-08		

Crop	Crop Height	Foliage Density	Application Rate (lb ai/A)	Activity	Transfer Coefficient (cm <sup>2</sup> /hr or gm/hr)	Non-Cancer		Cancer
						Dermal MOE <sup>2,3</sup> (LOC = 300)	DAT at which MOE ≥ LOC [MOE]	Cancer Risk Estimate
								0-DAT
Onion, bulb	LOW	FULL	2.4	Irrigation (hand set)	1900	220	3 [320]	6E-07
	LOW	FULL		Scouting	1400	290	1 [330]	4E-07
	LOW	FULL		Weeding, Hand	4200	98	9 [300]	1E-06
	LOW	MIN		Irrigation (hand set)	1900	220	3 [320]	6E-07
	LOW	MIN		Scouting	330	1200		1E-07
	LOW	MIN		Thinning Plants, Hand	330	1200		1E-07
	LOW	MIN		Weeding, Hand	1400	290	1 [330]	4E-07
Onion, green	LOW	FULL	2.4	Harvesting, Hand	1400	290	1 [330]	4E-07
	LOW	FULL		Irrigation (hand set)	1900	220	3 [320]	6E-07
	LOW	FULL		Scouting	1400	290	1 [330]	4E-07
	LOW	FULL		Weeding, Hand	4200	98	9 [300]	1E-06
	LOW	MIN		Irrigation (hand set)	1900	220	3 [320]	6E-07
	LOW	MIN		Scouting	330	1200		1E-07
	LOW	MIN		Weeding, Hand	1400	290	1 [330]	4E-07
	LOW	MIN		Thinning Plants, Hand	330	1200		1E-07
Parsley	LOW	FULL	1.5	Irrigation (hand set)	1900	350		4E-07
	LOW	FULL		Scouting	210	3100		4E-08
	LOW	FULL		Harvesting, Hand	1100	600		2E-07
	LOW	FULL		Weeding, Hand	70	9400		1E-08
	LOW	MIN		Irrigation (hand set)	1900	350		4E-07
	LOW	MIN		Scouting	210	3100		4E-08
	LOW	MIN		Thinning Plants, Hand	70	9400		1E-08
	LOW	MIN		Weeding, Hand	70	9400		1E-08
	LOW	MIN		Transplanting	230	2900		4E-08
	LOW	FULL		Irrigation (hand set)	1900	350		4E-07
	LOW	FULL		Scouting	210	3100		4E-08
	LOW	FULL		Harvesting, Hand	1100	600		2E-07
	LOW	FULL		Weeding, Hand	70	9400		1E-08
	LOW	MIN		Irrigation (hand set)	1900	350		4E-07
	LOW	MIN		Scouting	210	3100		4E-08
	LOW	MIN		Thinning Plants, Hand	70	9400		1E-08
	LOW	MIN		Weeding, Hand	70	9400		1E-08
	LOW	MIN		Transplanting	230	2900		4E-08
Peanut	LOW	FULL	1.6	Irrigation (hand set)	1900	320		4E-07
	LOW	FULL		Scouting	210	2900		4E-08
	LOW	FULL		Weeding, Hand	70	8800		1E-08
	LOW	MIN		Weeding, Hand	70	8800		1E-08

Crop	Crop Height	Foliage Density	Application Rate (lb ai/A)	Activity	Transfer Coefficient (cm <sup>2</sup> /hr or gm/hr)	Non-Cancer		Cancer
						Dermal MOE <sup>2,3</sup> (LOC = 300)	DAT at which MOE ≥ LOC [MOE]	Cancer Risk Estimate
								0-DAT
Pepper, bell	LOW	FULL	2.4	Harvesting, Hand	1100	370		3E-07
	LOW	FULL		Tying/Training	1100	370		3E-07
	LOW	FULL		Irrigation (hand set)	1900	220	3 [320]	6E-07
	LOW	FULL		Scouting	210	2000		6E-08
	LOW	FULL		Weeding, Hand	70	5900		2E-08
	LOW	MIN		Irrigation (hand set)	1900	220	3 [320]	6E-07
	LOW	MIN		Scouting	210	2000		6E-08
	LOW	MIN		Weeding, Hand	70	5900		2E-08
	LOW	MIN		Transplanting	230	1800		7E-08
	HIGH	FULL		Harvesting, Hand	1100	370		3E-07
Pepper, chili	LOW	FULL	2.4	Scouting	210	2000		6E-08
	LOW	FULL		Harvesting, Hand	1100	370		3E-07
	LOW	FULL		Pruning, Hand	70	5900		2E-08
	LOW	FULL		Irrigation (hand set)	1900	220	3 [320]	6E-07
	LOW	FULL		Scouting	210	2000		6E-08
	LOW	FULL		Weeding, Hand	70	5900		2E-08
	LOW	MIN		Irrigation (hand set)	1900	220	3 [320]	6E-07
	LOW	MIN		Scouting	210	2000		6E-08
	LOW	MIN		Weeding, Hand	70	5900		2E-08
	LOW	MIN		Transplanting	230	1800		7E-08
Potato	HIGH	FULL	1.68	Harvesting, Hand	1100	370		3E-07
	HIGH	FULL		Scouting	210	2000		6E-08
	LOW	FULL		Irrigation (hand set)	1900	310		4E-07
	LOW	FULL		Scouting	210	2800		4E-08
	LOW	FULL		Weeding, Hand	70	8400		1E-08
Potato, Sweet	LOW	MIN	1.6	Irrigation (hand set)	1900	310		4E-07
	LOW	MIN		Scouting	210	2800		4E-08
	LOW	FULL		Weeding, Hand	70	8800		1E-08
	LOW	FULL		Irrigation (hand set)	1900	320		4E-07
	LOW	FULL		Scouting	210	2900		4E-08
	LOW	MIN		Weeding, Hand	70	8800		1E-08
	LOW	MIN		Transplanting	230	2700		5E-08
Spinach	LOW	MIN	1.5	Irrigation (hand set)	1900	350		4E-07
	LOW	MIN		Scouting	210	3100		4E-08
	LOW	FULL		Harvesting, Hand	1100	600		2E-07
	LOW	FULL		Weeding, Hand	70	9400		1E-08
	LOW	FULL		Irrigation (hand set)	1900	350		4E-07
	LOW	MIN		Scouting	210	3100		4E-08

Table F-7. Occupational Post-Application Non-Cancer and Cancer Risk Summary for ETU.<sup>1</sup>

Crop	Crop Height	Foliage Density	Application Rate (lb ai/A)	Activity	Transfer Coefficient (cm <sup>2</sup> /hr or gm/hr)	Non-Cancer		Cancer
						Dermal MOE <sup>2,3</sup> (LOC = 300)	DAT at which MOE ≥ LOC [MOE]	Cancer Risk Estimate
						0-DAT		30-day Average Dose
	LOW	MIN		Thinning Plants, Hand	70	9400		1E-08
	LOW	MIN		Weeding, Hand	70	9400		1E-08
	LOW	MIN		Transplanting	230	2900		4E-08
	LOW	FULL		Irrigation (hand set)	1900	350		4E-07
	LOW	FULL		Scouting	210	3100		4E-08
	LOW	FULL		Harvesting, Hand	1100	600		2E-07
	LOW	FULL		Weeding, Hand	70	9400		1E-08
	LOW	MIN		Irrigation (hand set)	1900	350		4E-07
	LOW	MIN		Scouting	210	3100		4E-08
	LOW	MIN		Thinning Plants, Hand	70	9400		1E-08
	LOW	MIN		Weeding, Hand	70	9400		1E-08
	LOW	MIN		Transplanting	230	2900		4E-08
Swiss Chard	LOW	MIN	1.5	Transplanting	230	2900		4E-08
	LOW	MIN		Irrigation (hand set)	1900	350		4E-07
	LOW	FULL		Irrigation (hand set)	1900	350		4E-07
	LOW	FULL		Harvesting, Hand	1100	600		2E-07
	LOW	MIN		Scouting	210	3100		4E-08
	LOW	FULL		Scouting	210	3100		4E-08
	LOW	MIN		Thinning Plants, Hand	70	9400		1E-08
	LOW	MIN		Weeding, Hand	70	9400		1E-08
	LOW	FULL		Weeding, Hand	70	9400		1E-08
	LOW	MIN		Transplanting	230	2900		4E-08
	LOW	MIN		Irrigation (hand set)	1900	350		4E-07
	LOW	FULL		Irrigation (hand set)	1900	350		4E-07
	LOW	FULL		Harvesting, Hand	1100	600		2E-07
	LOW	MIN		Scouting	210	3100		4E-08
	LOW	FULL		Scouting	210	3100		4E-08
	LOW	MIN		Thinning Plants, Hand	70	9400		1E-08
	LOW	MIN		Weeding, Hand	70	9400		1E-08
	Tobacco	HIGH		FULL	1.96	Harvesting, Hand	800	630
HIGH		FULL	Weeding, Hand	90		5600		2E-08
HIGH		FULL	Irrigation (hand set)	1900		260	1 [300]	5E-07
HIGH		FULL	Scouting	90		5600		2E-08
LOW		FULL	Scouting	90		5600		2E-08
HIGH		FULL	Harvesting, Mechanically-assisted	800		630		2E-07
LOW		MIN	Scouting	90		5600		2E-08
LOW		MIN	Weeding, Hand	90		5600		2E-08
LOW		MIN	Transplanting	230		2200		6E-08
HIGH		FULL	Canopy Management	800		630		2E-07

Table F-7. Occupational Post-Application Non-Cancer and Cancer Risk Summary for ETU. <sup>1</sup>								
Crop	Crop Height	Foliage Density	Application Rate (lb ai/A)	Activity	Transfer Coefficient (cm <sup>2</sup> /hr or gm/hr)	Non-Cancer		Cancer
						Dermal MOE <sup>2,3</sup> (LOC = 300)	DAT at which MOE ≥ LOC [MOE]	Cancer Risk Estimate
								0-DAT
Tomato	LOW	FULL	2.4	Weeding, Hand	90	5600		2E-08
	LOW	FULL		Irrigation (hand set)	1900	260	1 [300]	5E-07
	HIGH	FULL		Harvesting, Hand	1100	370		3E-07
	LOW	FULL		Harvesting, Hand	1100	370		3E-07
	HIGH	FULL		Pruning, Hand	70	5900		2E-08
	LOW	FULL		Pruning, Hand	70	5900		2E-08
	HIGH	FULL		Tying/Training	1100	370		3E-07
	LOW	FULL		Tying/Training	1100	370		3E-07
	HIGH	FULL		Irrigation (hand set)	1900	220	3 [320]	6E-07
	LOW	FULL		Scouting	210	2000		6E-08
	LOW	FULL		Weeding, Hand	70	5900		2E-08
	HIGH	FULL		Weeding, Hand	70	5900		2E-08
	LOW	MIN		Pruning, Hand	70	5900		2E-08
	LOW	MIN		Tying/Training	1100	370		3E-07
	LOW	MIN		Scouting	210	2000		6E-08
	LOW	MIN		Weeding, Hand	70	5900		2E-08
	LOW	MIN		Transplanting	230	1800		7E-08
	Wheat, spring	HIGH		FULL	1.6	Scouting	210	2000
LOW		FULL	Scouting	1100		560		2E-07
LOW		MIN	Scouting	1100		560		2E-07
LOW		MIN	Weeding, Hand	70		8800		1E-08
Wheat, winter	LOW	FULL	1.6	Weeding, Hand	70	8800		1E-08
	LOW	FULL		Scouting	1100	560		2E-07
	LOW	MIN		Weeding, Hand	70	8800		1E-08
	LOW	MIN		Scouting	1100	560		2E-07
Greenhouse Tomato DFR Data (MRID 44959603)								
Greenhouse vegetable	HIGH	FULL	2.25	Harvesting, Hand	1200	490		3E-07
	LOW	FULL		Harvesting, Hand	1200	490		3E-07
	LOW	MIN		Pinching	1200	490		3E-07
	HIGH	FULL		Pinching	1200	490		3E-07
	HIGH	FULL		Pollination	1200	490		3E-07
	LOW	FULL		Pruning, Hand	1200	490		3E-07
	HIGH	FULL		Scouting	1200	490		3E-07
	HIGH	FULL		Turning	1200	490		3E-07
	HIGH	FULL		Tying/Training	1200	490		3E-07
	HIGH	FULL		Weeding, Hand	1200	490		3E-07
	LOW	MIN		Propagating	1200	490		3E-07
	LOW	MIN		Pruning, Hand	1200	490		3E-07
	LOW	MIN		Scouting	1200	490		3E-07

Table F-7. Occupational Post-Application Non-Cancer and Cancer Risk Summary for ETU. <sup>1</sup>								
Crop	Crop Height	Foliage Density	Application Rate (lb ai/A)	Activity	Transfer Coefficient (cm <sup>2</sup> /hr or gm/hr)	Non-Cancer		Cancer
						Dermal MOE <sup>2,3</sup> (LOC = 300)	DAT at which MOE ≥ LOC [MOE]	Cancer Risk Estimate
								0-DAT
	LOW	MIN		Weeding, Hand	1200	490		3E-07
	LOW	MIN		Transplanting	230	2600		6E-08
	HIGH	FULL		Pruning, Hand	1200	490		3E-07
	HIGH	FULL		Irrigation (hand watering)	230	2600		6E-08
Greenhouse Crop (Ornamentals, Non-bearing Plants)	HIGH	FULL	1.6	Harvesting, Hand	230	3600		5E-08
	LOW	FULL		Harvesting, Hand	230	3600		5E-08
	HIGH	FULL		Pruning, Hand	230	3600		5E-08
	LOW	FULL		Pruning, Hand	230	3600		5E-08
	HIGH	FULL		Scouting	230	3600		5E-08
	LOW	FULL		Scouting	230	3600		5E-08
	HIGH	FULL		Container Moving	230	3600		5E-08
	HIGH	FULL		Weeding, Hand	230	3600		5E-08
	LOW	FULL		Weeding, Hand	230	3600		5E-08
	HIGH	FULL		Transplanting	230	3600		5E-08
	LOW	FULL		Transplanting	230	3600		5E-08
	LOW	MIN		Grafting	230	3600		5E-08
	HIGH	MIN		Harvesting, Hand	230	3600		5E-08
	LOW	MIN		Propagating	230	3600		5E-08
	HIGH	MIN		Pruning, Hand	230	3600		5E-08
	HIGH	MIN		Transplanting	230	3600		5E-08
	LOW	MIN		Transplanting	230	3600		5E-08
	LOW	FULL		Pinching	230	3600		5E-08
	HIGH	FULL		Pinching	230	3600		5E-08
	LOW	FULL		Tying/Training	230	3600		5E-08
CA Mancozeb/CA Highest ETU Residue TTR Data								
Golf Course	LOW	FULL	17.4	Maintenance	3700	270	1 [300]	5E-07
Golf Course	LOW	FULL		Maintenance, greens only	2500	390		3E-07
Sod	LOW	FULL	17.4	Maintenance	6700	150	7 [330]	9E-07
Sod	LOW	FULL		Harvesting, Slab	6700	150	7 [330]	9E-07
Sod	LOW	FULL		Transplanting/Planting	6700	150	7 [330]	9E-07

1. DAT = day after treatment. MOE = margin of exposure. LOC = level of concern.

2. Total Dermal Dose = ETU Dermal Dose (mg/kg/day) + Metabolized ETU Dermal Dose (mg/kg/day)

ETU Dermal Dose = [DFR/TTR (µg/cm<sup>2</sup>) × Transfer Coefficient × 0.001 mg/µg × 8 hrs/day × dermal absorption (6%)], BW (80 kg).

Metabolized ETU Dermal Dose = [DFR/TTR (µg/cm<sup>2</sup>) × Transfer Coefficient × 0.001 mg/µg × 8 hrs/day × Metabolic Conversion Factor (7.5%)\* × dermal absorption (6%)], BW (80 kg).

3. MOE = POD (0.2 mg/kg/day) / Daily Dermal Dose (mg/kg/day).

\* See Section 4.0 for details.