7 February 2000

MEMORANDUM

SUBJECT: **REVISED** OCCUPATIONAL AND RESIDENTIAL EXPOSURE ASSESSMENT AND RECOMMENDATIONS FOR THE REREGISTRATION ELIGIBILITY DECISION DOCUMENT FOR DISULFOTON

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Please find attached the occupational and residential review of disulfoton.

DP Barcode:	238096
Pesticide Chemical Codes:	032501
EPA Reg Nos.:	4-153, 4-253, 192-74, 192-126, 239-2134, 264-464, 400-408, 400-411, 400-475, 572-346, 769-850, 769-908, 802-426, 869-76, 69-223, 2935-435, 3125-83, 3125-116, 3125-172, 3125-183, 3125-307, 5481-415, 5887-61, 8660-125, 9688-94, 11474-70, 32802-32, 33955-489, 34704, 475, 34704-586, 28293-277, 42057-51, 46260-2, 46260-10, 49585-28, 59144-23, CA 92002500, CA 960014, NC 92001100, OR 91002700, TX 90000400, VA 92000600, WA 92002600
EPA MRID No.:	404690-01, 405041-05, and 422294-01
PHED:	Yes, Version 1.1

OCCUPATIONAL AND RESIDENTIAL EXPOSURE AND RISK ASSESSMENTS

EXPOSURE AND RISK ASSESSMENT/CHARACTERIZATION

Purpose

In this document, which is for use in EPA's development of the Disulfoton Reregistration Eligibility Decision Document (RED), EPA presents the results of its review of the potential human health effects of occupational and residential exposure to disulfoton.

Criteria for Conducting Exposure Assessments

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

Summary of Toxicity Concerns Relating to Occupational and Residential Exposures

Acute Toxicology Categories

Table 1 below presents the acute toxicity categories based on the active ingredient as outlined in the Hazard Identification document.[1]

Table 1: Acute Toxicity Categories for Disulfoton

Guideline Number	Toxicity Category	MRID Number	Results	Toxicity Category
81-1	acute oral	Acc 072293 Doc 003958 P41	LD_{50}= M: 6.2 mg/kg F: 1.9 mg/kg	I
81-2	acute dermal	Acc 07793 Doc # 03958 P71 & 004223, p.24	LD_{50}= M: 15.9 mg/kg F: 3.6 mg/kg	I
81-3	acute inhalation	Acc 258569 Doc # 05789	LC_{50}= M: 0.06 mg/L F: 0.89 mg/L	I
81-4	primary eye irritation	Data requirement waived. Doc # 03958 p. 12: 004223. p14		
81-5	primary dermal irritation	Data requirement waived. Doc # 03958 p. 12: 004223. p14		
81-6	dermal sensitization	Data requirement waived. Doc # 03958 p. 12:		
81-8	acute neurotoxicity	42755801	Reversible neurotoxic signs consistent with the cholinesterase inhibition. 1.5 mg/kg in females and 5.0 mg/kg in males	

Other Endpoints of Concern

The Hazard Identification document for disulfoton, indicates that there are toxicological endpoints of concern. The endpoints used in assessing the risks for disulfoton are presented in the following Table 2.

Table 2: Endpoints for Assessing Occupational and Residential Risks for Disulfoton[1]

Test	Results
Short-term Dermal Exposure (1 to 7 days)	0.4 mg/kg/day based on a 21 day dermal study in rabbits (Target MOE = 100)
Intermediate-term Dermal Exposure (1 week to several months)	0.03 mg/kg/day based on a special 6 month cholinesterase inhibition feeding study (Target MOE = 100)
Inhalation Exposure (All-time periods)	0.00016 mg/L (Target MOE = 100)
Dermal Absorption	36%
Inhalation Absorption	100%

SUMMARY OF USE PATTERN AND FORMULATIONS

Occupational-Use and Homeowner-Use Products

At this time products containing disulfoton are intended for both homeowner and occupational uses. Residential uses include small vegetable gardens, ornamental flowers and shrubs including rose bushes and small trees and potted plants (indoor and outdoor). Occupational registrations include terrestrial food and feed crops, indoor greenhouse non-food crops, forest trees, ornamental herbaceous plants, ornamental woody shrubs and vines, ornamental shade trees.[2,3]

Type of pesticide/target pests

Disulfoton, (O,O-Diethyl S-[2-(ethylthio)ethyl] phosphorodithioate) is a selective systemic organophosphate insecticide used to control a variety of sucking insects. Examples of the type of insects that disulfoton controls include (but are not limited to) the following:[3]

- Vegetables and Field Crops: Aphids, Leafhoppers, Mexican bean beetle larvae, Mites, Thrips and Potato psyllid, Grasshoppers, Flea beetles, Southern potato wireworms, Root aphids, Green peach aphids, Colorado potato beetles, Hessian fly; and

- Ornamental shrubs, trees and rose bushes: Aphids, Birch leaf miner, Elm leaf beetle, European elm scale, Lace bug, Leafhoppers, Mites, Thrips, Whiteflies,

Birch leafminers, Camellia scale, Holly leafminer, Leafhoppers, Mimosa webworm, Pine tip moth, Soft scale, Spider mites, Tea scale, Thrips and Whiteflies.

Formulation types and percent active ingredient

Disulfoton is formulated as a technical product (98.5 percent active ingredient), an emulsifiable concentrate (85, 23, and 17.5 percent active ingredient), and as a granular (15, 10, 6.5, 2, 1, 0.625, 0.5, and 0.37 percent active ingredient). It is often formulated in combination with fertilizers.

Registered use sites[2,3]

Occupational-use sites

Disulfoton has been registered for occupational-use on agricultural crops, ornamental flowers and shrubs, non-bearing fruit trees, and nut trees. The occupational crops use sites in this RED have been grouped as follows:

- **Agricultural Crops (food and feed crops)**, including peppers, broccoli, brussel sprouts, cabbage, chinese cabbage, cauliflower, lettuce, spinach, asparagus, radishes, black and red raspberries, tomatoes, barley, field corn, oats, triticale, wheat, cotton, peanuts, peas, sorghum, soybeans, white/irish potatoes, dried, lima, and snap beans, lentils, sweet corn, sugar beets and popcorn and strawberries (propagating plants only) and tobacco;

- **Nut Trees**, specifically pecans growing in the south central and southwestern regions of the United States;

- **Non-Bearing Fruit Trees**, including apples, crabapples, pears, apricots, cherries, peaches, plums and prunes. Disulfoton is not applied to trees that will bear fruit during the current crop year;

- **Ornamental Flowers/Groundcover,** including annuals and bulbs;

- **Ornamental Shrubs and Trees,** including Christmas trees; and

- **Potted Plants,** both indoor and outdoor**.**

Non-occupational-use sites

Potential residential and non-occupational use sites may include indoor or outdoor residential sites (e.g., exposure to insecticide use on ornamentals), professional uses at residential sites (e.g., insecticide use on trees, shrubs, and other ornamentals), and professional sites where non-occupational exposure may occur (ornamental trees, parks, residential and recreational areas). The non-occupational crops use sites in this RED have been grouped as follows:

- **Residential Ornamental Flowers**, including annuals such as ageratum, calendulas, carnations, chrysanthemums, delphiniums, marigolds, petunias, snapdragons, zinnias, and bulbs;

- **Residential Ornamental Shrubs and Trees,** both evergreen and deciduous;

- **Residential Rose Bushes;**

- **Residential Vegetable Gardens,** including green, snap, and lima beans, brussel sprouts, broccoli, cabbage, cauliflower, lettuce and peas; and

- **Residential Potted Plants,** both indoor and outdoor.

Application Rates[2,3]

- **Agricultural Crops**: The application rate for commercial crops ranges from 8 lb active ingredient (ai)/acre to 0.5 lb ai/acre, including rates of 1.0 lb ai/acre for crops such as broccoli, brussel sprouts, cabbage and cauliflower, 2.0 lb ai/acre for lettuce, peppers, peanuts, 2.5 lb ai/acre for peas and lentils, and 4 lb ai/acre for tobacco and potatoes.

- **Nut Trees**: The maximum application rate for nut trees (i.e., pecan trees in the southern regions of the United States) is 3 lb ai/acre.

- **Non-Bearing Fruit Trees**: The application rate for pecan trees is 0.16 to 1.56 lb per tree (EPA Reg No. 3125-172). Based on the assumption of tree plantings with 10 foot centers, (435 trees/acre), the maximum application rate to non-bearing fruit trees is therefore 102 lb ai/acre.

- **Ornamental Flowers/Groundcover:** The maximum application rate is 28.6 lb ai/acre.

- **Shrubs and Trees**: (including Christmas trees): Based on the assumption of plantings using 10 foot centers, and 2-inch trunk diameters (when measured at a height of 4 feet), the application rate to trees is 20 lb ai/acre. The application rate to shrubs is 4.3 lb ai/acre, assuming 4 foot shrub height, and 435 shrubs/acre.

- **Potted Plants:** The application rate for granular hand method applications to potted plants is 0.00052 lb ai/12 inch pot.

- **Residential Ornamental Flowers**: The maximum application rate ranges from 0.3 lb ai/1,000 ft^2 to 0.005 lb ai/1,000 ft^2.

- **Residential Ornamental Shrubs and Small Trees:** The maximum application rates for granular applications range from 1.32 lb ai/four foot shrub or tree to 0.00032 lb ai/four foot shrub or tree.

- **Residential Rose Bushes:** The maximum application rate for granular application to rose bushes is 0.00188 lb ai/bush.

- **Residential Vegetable Gardens:** The maximum application rate ranges from 0.1125 lb ai/1,000 ft^2 to 0.0313 lb ai/1,000 ft^2.

- **Residential Potted Plants:** The maximum application rate for hand application of granulars to pots is 0.00011 lb ai/six inch pot.

Methods and Types of Equipment used for Mixing, Loading, and Application[2,3]

Disulfoton can be applied with ground or air equipment using broadcast, chemigation, high volume spray, low volume spray, seed treatment, soil band treatment, soil incorporated broadcast treatment, soil in-furrow treatment (drill and hill-drop), top dressing equipment, soil injection, soil sidedress, and by hand using a shaker can, spoon, or measuring scoop. Following application, disulfoton is soil incorporated into the top 2 to 3 inches of soil and may require watering in.

- **Agricultural Crops:** Granular formulations are typically applied in the seed furrow or in a soil incorporated band on each side of the seed furrow at planting. When used as a preplanting treatment, disulfoton is applied using broadcast granular or liquid spray equipment and then soil incorporated into the top 2 to 3 inches of soil. Examples include: for cotton, disulfoton granules are applied as a soil in furrow treatment applied over seed at planting or in a soil incorporated band on each side of the furrow which is then soil incorporated; for sorghum, applications are made at planting, and then into the whorl post planting; and for barley, drilling or broadcast at planting and broadcast after emergence.

- **Nut Trees** (specifically pecans grown in states of the South Central and Southwestern regions): Granulars are applied by treating 6 foot bands of soil on both sides of the trees, followed by soil incorporation into top 2 to 3 inches of soil and then watered in.

- **Non-Bearing Fruit Trees**: Granulars are applied uniformly from trunk to drip line on all sides, soil incorporated and watered in.

- **Flowers/Groundcover:** As a preplant treatment, granular formulations can be evenly applied to seed beds by hand or belly grinder, and then soil incorporated.

- **Shrubs and Trees:** (including Christmas trees) Application is made by soil injection or soil implantation with an auger or soil sampling tool. Granules are applied as a soil incorporated broadcast treatment, or evenly spread under shrub canopy, and then soil incorporated.

- **Potted Plants:** Applications are made by hand, and then soil incorporated.

- **Residential Ornamental Flowers:** Belly grinder applications can be used for preplanting treatment, or treatments can be applied by hand using a spoon, measuring cup, or shaker can, and then soil incorporated.

- **Residential Ornamental Shrubs**: Applications are made by distributing granules uniformly under the shrub canopy by hand using a spoon, measuring cup, or shaker can and soil incorporated and then watered in.

- **Residential Rose Bushes:** Belly grinder applications can be made for preplanting treatment. At planting, or to established bushes, application of granulars is made by hand using a spoon, measuring cup, or shaker can.

- **Residential Vegetable Gardens:** Belly grinder applications can be made for preplanting treatment. At planting, or to established shrubs or trees, application of granulars is made by hand using a spoon, measuring cup, or shaker can.

- **Residential Potted Plants:** Applications are made by hand by punching a hole into soil and pouring granules into the holes or sprinkling granules on the soil and soil incorporating.

Registrant-Proposed Changes to Current Use Patterns

Bayer Corporation in a letter to Philip Poli dated March 8, 1999 stated that it is proposing the following changes in the two primary disulfoton labels: Di-Syston 8 Emulsifiable Systemic Insecticide (EPA reg. No. 3125-307) and Di-Syston 15% Granular Systemic Insecticide (EPA Reg. No. 3125-172):

Cotton:	Foliar application eliminated. Three soil applications (3 lb ai/acre total) reduced to one soil application of 1 lb ai/acre.
Potatoes:	Two soil applications (8 lbs ai/acre total) reduced to one soil application of 3 lbs ai/acre. Foliar use (3 lbs ai/acre) eliminated in the West. Foliar use is now 1 lb ai/acre (East of the Rocky Mts. only).
Wheat:	Two foliar applications (1.5 lb ai/acre total) reduced to one foliar application (0.75 lb ai/acre total).
Peanuts:	Soil application reduced from 2 lbs ai/acre to 1 lb ai/acre.
Beans:	Reduce 15 G rate from 2 lbs ai/acre to 1 lb ai/acre.
Tobacco:	Total amount allowed set at 4 lb ai/acre.

Sorghum: Two soil applications (2 lb ai/acre total) reduced to one soil application (1 lb ai/acre). Three foliar applications (1.5 lb ai/acre total) reduced to two foliar applications (1.0 lb ai/acre total).

Brussel Sprouts, Cauliflower: Two soil applications (2 lbs ai/acre total) reduced to one soil application (1 lb ai/acre total).

Tomatoes, Oats, Corn, Pecans: All uses canceled.

Bayer has also requested voluntary cancellation of Di-Syston Systemic Insecticide for Vegetables (EPA Reg. No. 3125-126).

All of the rate reductions being proposed by Bayer are already captured in the range of application rates presented in the occupational and residential exposure assessment, except the 0.75 lb ai/acre rate. To provide an indication of what reduction to the 0.75 lb ai/acre would mean in terms of occupational handler exposure, EPA has added an assessment for the 0.75 lb ai/acre rate to this occupational handler assessment. The footnotes to Table 4 indicate the current application rates and proposed application rates as they pertain to the occupational exposure assessment.

The registrant proposal for the voluntary cancellation and rate reduction will be evaluated later in the reregistration process after EPA has received public comment and input from all stakeholders.

ASSESSMENT/CHARACTERIZATION

Occupational Exposures and Risks

Handler Exposures & Risks

EPA has determined that there are potential exposures to mixers, loaders, applicators, or other handlers during usual use-patterns associated with disulfoton. Based on the use patterns, 15 major exposure scenarios were identified for disulfoton: (1a) mixing, loading liquid formulations (emulsifiable concentrates) for aerial/chemigation application; (1b) mixing, loading liquid formulations (emulsifiable concentrates) for groundboom application; (1c) mixing, loading liquid formulations (emulsifiable concentrates) for orchard airblast sprayer application; (2a) loading granulars for aerial application; (2b) loading granulars for tractor-drawn spreader application; (3) applying sprays with a fixed-wing aircraft; (4) applying granulars with a fixed-wing aircraft; (5) applying sprays with a helicopter; (6) applying granulars with a helicopter; (7) applying sprays with a groundboom; (8) applying sprays to orchards with an airblast; (9) applying granulars with a tractor-drawn spreader; (10) loading and applying granulars using a belly grinder; (11) loading and applying granulars with a push-type granular spreader; (12) applying granulars by hand, with a spoon, shaker can, or a measuring scoop; (13) applying ready-to-use liquid as a seed soak treatment; (14) flagging during aerial spray applications; and (15) flagging during aerial granular applications.

Handler Exposure Scenarios -- Data and Assumptions

An exposure assessment for each scenario was developed, where appropriate data are available, using the *Pesticide Handlers Exposure Database (PHED) Version 1.1*.[4] Table 3 summarizes the caveats and parameters specific to the surrogate data used for each scenario and corresponding exposure/risk assessment. These caveats include the source of the data and an assessment of the overall quality of the data. The assessment of data quality is based on the number of observations and the available quality control data. The quality control data are based on a grading criteria established by the PHED task force.

The following assumptions and factors were used in order to complete this exposure assessment:

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

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

- Daily acres and volumes (as appropriate) to be treated in each scenario include:
  - 350 acres for aerial and chemigation applications in agricultural settings (including flaggers supporting aerial applications)
  - 80 acres for groundboom spraying of agricultural areas
  - 80 acres for tractor-drawn spreader application to agricultural settings
  - 40 acres for orchard airblast application
  - 2 acres for application of granular formulations to orchards and ornamental flower or groundcover nursery stock using a tractor-drawn spreader
  - 2 acres for application of granular formulations to agricultural fields using a belly grinder
  - 350 pots (12 inch diameter) treated when applying and soil incorporating granulars by hand with a spoon, shaker can, or a measuring scoop.

- Calculations are completed at the maximum application rates for specific crops recommended by the available disulfoton labels to bracket risk levels associated with the various use patterns.

- *Helicopter Application of Sprays:* Data from PHED for helicopter application of sprays are based on a very limited number of replicates. Instead of assessing this exposure scenario using inadequate data, data from PHED for fixed-wing application of sprays were used in accordance with HED Science Advisory Council for Exposure Policy Number 5 (May 7, 1998)

- Due to a lack of scenario-specific data, HED is often forced to calculate unit exposure values using generic protection factors (PF) that are applied to represent various risk mitigation options (i.e., the use of Personal Protective Equipment (PPE) and engineering controls). PPE protection factors include those

representing a double layer of clothing (50 percent PF), chemical resistant gloves (90 percent PF) and respiratory protection (80 percent PF) for use of dust/mist mask. Engineering controls are generally assigned a PF of 98 percent.

Handler Exposure and Non-Cancer Risk Estimates

Handler exposure assessments are completed by EPA using a baseline exposure scenario and, if required, increasing levels of risk mitigation (PPE and engineering controls) to achieve an appropriate margin of exposure (MOE). The baseline scenario generally represents a handler wearing long pants, a long-sleeved shirt, and no chemical-resistant gloves. The following tables present risk assessment calculations for the handling of disulfoton. Table 4 presents the short-term and intermediate-term dermal, and inhalation exposures at baseline. Table 5 presents the dermal and inhalation risks for those scenarios at baseline. Table 6 presents the occupational short-term and intermediate-term doses and risks when wearing PPE risk mitigation. Table 7 presents the same dose/risk calculations when employing engineering controls (e.g., enclosed cab or cockpit, and packaging for closed loading of granulars).

The calculations of daily dermal and inhalation exposure to disulfoton by handlers are used to calculate the daily dose and hence the risks, to those handlers. Potential daily dermal exposure is calculated using the following formula:

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

The potential short-term and intermediate-term dermal doses were calculated using the following formulae:

$$Short\text{-}term\ Daily\ Dermal\ Dose\left(\frac{mg\ ai}{kg/day}\right) = Short\text{-}term\ Daily\ Dermal\ Exposure\left(\frac{mg\ ai}{day}\right) x\left(\frac{1}{Body\ Weight\ (kg)}\right)$$

$$Intermediate\text{-}term\ Daily\ Dermal\ Dose\left(\frac{mg\ ai}{kg/day}\right) = Intermediate\text{-}term\ Daily\ Dermal\ Exposure\left(\frac{mg\ ai}{day}\right) x\left(\frac{1}{Body\ Weight\ (kg)}\right)$$

The short-term and intermediate-term dermal MOEs were calculated using the following formulae:

$$Short\text{-}term\ Dermal\ MOE = \frac{Short\text{-}term\ NOEL\left(\frac{mg}{kg/day}\right)}{Short\text{-}term\ Dermal\ Daily\ Dose\left(\frac{mg}{kg/day}\right)}$$

The short-term MOEs were calculated using a NOAEL of 0.4 mg/kg/day. The intermediate-term MOEs were calculated using a NOAEL of 0.03 mg/kg/day assuming 36 percent dermal absorption.

$$\text{Intermediate-term Dermal MOE} = \frac{\text{Intermediate-term NOEL}\left(\frac{mg}{kg/day}\right)}{\text{Intermediate-term Dermal Daily Dose}\left(\frac{mg}{kg/day}\right)} * \text{Dermal Absorption Factor}$$

Potential daily inhalation exposure was calculated using the following formula:

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

The potential short-term and intermediate-term inhalation doses were calculated using the following formulae:

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

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

For disulfoton, the inhalation doses were calculated using a 70 kg body weight and an inhalation absorption rate of 100 percent.

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

The short-term and intermediate-term inhalation MOEs were calculated using the following formulae:

Both short-term and intermediate-term inhalation MOEs were calculated using a NOAEL of 0.045 mg/kg/day (assuming 100% inhalation absorption) for both short-term and intermediate-term inhalation toxicity. The inhalation NOAEL of 0.00016 mg/L was based on a study using

Fisher rats. This concentration was converted to a dose (mg/kg/day) using respiratory volume of 7.15 liters/hour and a body weight of 0.152 kg for Fisher rats.

The inhalation and dermal MOEs were calculated using the following formulas:

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

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

The total MOE was calculated using the following formula:

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

Table 3: Exposure Scenario Descriptions for the Use of Disulfoton

Exposure Scenario (Number)	Data Source	Standard Assumptions[a] (8-hr work day)	Comments[b]
Mixer/Loader Descriptors			
Mixing/Loading Liquid Formulations (Emulsifiable Concentrates) (1a/1b/1c)	PHED V1.1	350 acres for aerial and chemigation in agricultural settings, 80 acres for groundboom application, and 40 acres for orchard airblast applications	**Baseline:** Hands, dermal, and inhalation = AB grades. Hands = 53 replicates; dermal = 72 to 122 replicates; and inhalation = 85 replicates. High confidence in hands, dermal and inhalation data. No protection factor was needed to define the unit exposure value. **PPE:** The same dermal data are used as for the baseline coupled with a 50% protection factor to account for an additional layer of clothing. A 5-fold PF (e.g. 80% PF was applied to the baseline inhalation data to account for the use of a dust mist respirator. Hands = AB grades with 59 replicates. High confidence in hands, dermal data. **Engineering Controls:** Mechanical transfer method. Hands, dermal and inhalation unit exposures = AB grades. Hands = 31 replicates; dermal = 16 to 22 replicates, and inhalation = 27 replicates. High confidence in dermal, hand and inhalation data. Gloves were worn during the use of the engineering controls.
Loading Granular Formulations (2a, 2b)	PHED V1.1	350 acres for aerial application, 80 acres for tractor drawn spreader agricultural application, and 2 acres for ornamental flowers/groundcover, and trees	**Baseline:** Hands = All grade, dermal = ABC grade, and inhalation = AB grade. Hands = 10 replicates; dermal = 33 to 78 replicates; and inhalation = 58 replicates. Low confidence in dermal/ hand data. High confidence in inhalation data. **PPE**: Hands = AB grade, dermal = ABC grade. Dermal = 45 replicates, hands = 12-59 replicates. Low confidence in dermal and hands data. A 5-fold PF was applied to the baseline inhalation data to account for the use of a dust mist respirator. **Engineering Controls:** Closed loading of granulars. 98% PF was applied to baseline data.
Applicator Descriptors			
Applying Liquid Formulations (Emulsifiable Concentrates) with a Fixed-Wing Aircraft (3,4)	PHED V1.1	350 acres for aerial	**Baseline:** No data **PPE:** No data **Engineering Controls:** Hands = AB grade, dermal and inhalation = ABC grade. Medium confidence in hands/dermal and inhalation data. Hands = 34 replicates, dermal = 24-48 replicates, and inhalation = 23 replicates.
Applying Granulars with a Fixed-Wing Aircraft (4)	PHED V1.1	350 acres for aerial	**Baseline:** No data **PPE:** No data **Engineering Controls:** Hands and inhalation - All grade, dermal - C grade. Hands = 4 replicates, inhalation = 13 replicates, and dermal = 0-13 replicates. Low confidence in all data.

Table 3: Exposure Scenario Descriptions for the Use of Disulfoton (Continued)

Exposure Scenario (Number)	Data Source	Standard Assumptions[a] (8-hr work day)	Comments[b]
Applying Liquid Formulations (Emulsifiable Concentrations) with a Helicopter (5,6)	PHED V1.1	See fixed-wing aircraft.	See fixed-wing aircraft.
Applying Granulars with a Helicopter (6)	No Data	No Data	No Data
Applying Sprays with a Groundboom (7)	PHED V1.1	80 acres in agricultural applications	**Baseline:** Hand, dermal, and inhalation = AB grades. Hands = 29 replicates, dermal = 23 to 42 replicates, and inhalation = 22 replicates. High confidence in hand, dermal, and inhalation data. **PPE:** The same dermal and inhalation data are used as for the baseline coupled with a 50% protection factor to account for an additional layer of clothing, and an 80% PF to account for the use of a dust mist respirator, respectively. Hands data are ABC grades with 21 replicates. Medium confidence in hands, and dermal data. **Engineering Controls:** Hands and dermal = ABC grade, inhalation = AB grade. Hands = 16 replicates, dermal = 20-31 replicates, inhalation = 16 replicates. Medium confidence in hands and dermal data, and high confidence in inhalation data.
Applying Sprays to Orchards with an Airblast (8)	PHED V1.1	40 acres for orchard spraying	**Baseline**: Hand, dermal and inhalation are AB grade. Hands 22 replicates, dermal = 32 to 49 replicates, and inhalation = 47 replicates. High confidence in hand, dermal and inhalation data. **PPE**: Hands and dermal = AB grade. Hands = 18 replicates, dermal = 31 to 48 replicates. High confidence in hands and dermal data. A 5-fold (80% PF) was applied to baseline inhalation data to account for use of dust-mist respirator. **Engineering Controls**: Dermal = AB grade, inhalation = ABC grade, hands = AB grade. Low confidence in inhalation and dermal data. Inhalation = 9 replicates, dermal = 20-30 replicates, and hands = 20 replicates. A 90% PF was applied to gloved data to represent no gloved scenario.

Table 3: Exposure Scenario Descriptions for the Use of Disulfoton (Continued)

Exposure Scenario (Number)	Data Source	Standard Assumptions[a] (8-hr work day)	Comments[b]
Applying Granulars with a Tractor-Drawn Spreader (9)	PHED V1.1	80 acres for agriculture and 2 acres for ornamental flowers / groundcover application	**Baseline:** Hands, dermal and inhalation = AB grades. Low confidence in hands, dermal and inhalation data. Hands = 5 replicates, dermal = 1-5 replicates and inhalation = 5 replicates. **PPE:** The same hand and dermal data are used as for the baseline coupled with a 90% PF to account for chemical resistant gloves, and a 50% PF to account for an additional layer of clothing, respectively. The same inhalation data are used as for the baseline coupled with an 80% PF to account for the use of a dust mist respirator. **Engineering Controls:** Hands, dermal and inhalation data are AB grades. Hands = 24 replicates, dermal = 27 to 30 replicates, and inhalation = 2-30 replicates. High confidence in hands, dermal and inhalation data.
Mixer/Loader/Applicator Descriptors			
Loading/Applying Granulars Using a Belly Grinder (10)	PHED V1.1	2 acres for agricultural and ornamental flowers / groundcover application	**Baseline:** Hands and dermal = ABC grades and inhalation = AB grade. Medium confidence in hands/dermal data and high confidence in inhalation data. Hands = 23 replicates, dermal = 29-45 replicates and inhalation = 40 replicates. **PPE:** = Gloved data for hands = ABC grade with 15 replicates. The dermal data are taken from the baseline coupled with a 50% protection factor to account for an additional layer of clothing. A 5-fold protection factor (80% PF) was applied to baseline inhalation data to account for use of dust mist respirator. **Engineering Controls:** Not feasible
Loading/Applying Formulation Using a Push-Type Granulars Spreader (11)	PHED V1.1	2 acres for agricultural, ornamental flowers/groundcover, shrubs and tree application	**Baseline:** Hand and dermal = C grades, and inhalation = B grade. Hand = 15 replicates, dermal = 0-15 replicates, and inhalation = 15 replicates. Low confidence in hand and dermal data, and high confidence in inhalation data. **PPE:** The same dermal and hand data are used as for the baseline coupled with a 50% protection factor to account for an additional layer of clothing and a 90% protection factor to account for the use of chemical resistant gloves. A 5-fold protection factor (80% PF) was applied to the inhalation data to account for use of dust mist respirator. **Engineering Controls:** Not feasible.

Table 3: Exposure Scenario Descriptions for the Use of Disulfoton (Continued)

Exposure Scenario (Number)	Data Source	Standard Assumptions[a] (8-hr work day)	Comments[b]
Loading/Applying Granulars by Hand, Shaker Can, or with a Measuring Spoon (12) (PHED values for Granular Bait Dispersed by Hand used as a surrogate for these application methods)	PHED V1.1	350 pots	**Baseline:** Dermal and Inhalation = ABC grades, both with 16 replicates. Low confidence in dermal, and medium confidence in inhalation. Hand data back-calculated from gloved data, assuming 90% PF. **PPE:** Gloved data for hands = ABC grade with 15 replicates. The dermal data are taken from the baseline coupled with a 50% PF to account for an additional layer of clothing. Both a 80% PF (dust mist mask), and 90% PF (organic vapor respirator) were applied to baseline inhalation exposure values to account for the use of respective respirators. **Engineering Controls:** Not applicable.
Applying Ready-to-Use Liquid as a Seed Treatment (13)	PHED V1.1	No Data	No Data
Flagger Exposure			
Flagging Aerial Spray Applications (14)	PHED V1.1	350 acres	**Baseline:** Hands, dermal and inhalation data = AB grades. High confidence in dermal, hands and inhalation. Hands = 30 replicates, Inhalation = 28 replicates, and dermal = 18-28 replicates. **PPE:** Dermal and hands = AB grade. Hands = 6 replicates, dermal = 18-28 replicates. Low confidence for dermal and hands data. A 50% PF was applied to baseline data to represent dust mist masks. **Engineering Controls:** Hands and dermal = ABC grade, inhalation = AB grade. Inhalation = 16 replicates, dermal = 16 replicates, and dermal = 20-31 replicates. Medium confidence in hands, dermal data, and high confidence in inhalation data. These data are based on groundboom enclosed cab data.
Flagging Aerial Granular Applications (15)	PHED V1.1	350 acres	**Baseline:** Hands and dermal = ABC grades. Dermal = 16-20 replicates, and hands = 4 replicates. Dermal values based on total deposition data assuming 50% PF applied to no clothes values. Inhalation = E grade with 4 replicates. Low confidence in all values. **PPE:** Dermal value based on 50% PF over baseline to account for double layer of clothes. Hands values based on 90% PF over baseline to account for use of gloves, and inhalation values based on 50% PF over baseline to account for use of dust mist mask. **Engineering Controls:** Hands, dermal and inhalation = AB grades with high confidence. Hands = 24 replicates, dermal = 27 to 30 replicates and inhalation = 37 replicates. All data based on granular drop type tractor drawn spreader enclosed cab.

Table 3: Exposure Scenario Descriptions for the Use of Disulfoton (Continued)

Footnotes:

[a] All Standard Assumptions are based on an 8-hour work day as estimated by HED.

[b] All handler exposure assessments in this document are based on the "Best Available" data as defined by the PHED SOP for meeting Subdivision U Guidelines (i.e., completing exposure assessments). Best available grades are assigned to data as follows: matrices with A and B grade data (i.e., Acceptable Grade Data) and a minimum of 15 replicates; if not available, then grades A, B and C data and a minimum of 15 replicates; if not available, then all data regardless of the quality (i.e., All Grade Data) and number of replicates. High quality data with a protection factor take precedence over low quality data with no protection factor. Generic data confidence categories are assigned as follows:

High = grades A and B and 15 or more replicates per body part
Medium = grades A, B, and C and 15 or more replicates per body part
Low = any run that included D or E grade data or has less than 15 replicates per body part.

Table 4. Occupational Handler Dermal and Inhalation Exposures to Disulfoton at Baseline

Exposure Scenario (Scenario #)	Baseline Dermal Unit Exposure[a] (mg/lb ai)	Baseline Inhalation Unit Exposure[b] (g/lb ai)	Range of Application Rates[c] (lb ai/acre)	Crop Type or Target[d]	Amount Handled per Day[e]	Daily Dermal Exposure[f] (mg/day)	Daily Inhalation Exposure[g] (mg/day)
Mixer/Loader Exposure							
Mixing/Loading Liquid Formulations (Emulsifiable Concentrates) for Aerial/Chemigation Application (1a)	2.9	1.2	3 lb ai/acre (chemigation only)	Ag	350 acres	3,000	1.3
			1 lb ai/acre			1,000	0.42
			0.5 lb ai/acre			510	0.21
Mixing/Loading Liquid Formulations (Emulsifiable Concentrates) for Groundboom Application (1b)	2.9	1.2	4 lb ai/acre	Ag	80 acres	930	0.38
			1 lb ai/acre			230	0.096
			0.5 lb ai/acre			120	0.048
Mixing/Loading Liquid Formulations (Emulsifiable Concentrates) for Orchard Airblast Sprayer Application (1c)	2.9	1.2	3 lb ai/acre	Ag	40 acres	350	0.14
Loading Granulars for Aerial Application (2a)	0.0084	1.7	2 lb ai/acre	Ag	350 acres	5.9	1.2
			1 lb ai/acre			2.9	0.60
			0.75 lb ai/acre (proposed)			2.2	0.45
Loading Granulars for Tractor-Drawn Spreader Application (2b)	0.0084	1.7	8 lb ai/acre	Ag	80 acres	5.4	1.1
			4 lb ai/acre			2.7	0.54
			1 lb ai/acre			0.67	0.14
			0.75 lb ai/acre (proposed)			0.50	0.10
			3 lb ai/acre	Nut Trees	2 acres	0.050	0.010
			102 lb ai/acre[h]	Non-Bearing Fruit Trees		1.7	0.35
			28.6 lb ai/acre	Flowers/Groundcover		0.48	0.097

Table 4. Occupational Handler Dermal and Inhalation Exposures to Disulfoton at Baseline (Continued)

Exposure Scenario (Scenario #)	Baseline Dermal Unit Exposure[a] (mg/lb ai)	Baseline Inhalation Unit Exposure[b] (g/lb ai)	Range of Application Rates[c] (lb ai/acre)	Crop Type or Target[d]	Amount Handled per Day[e]	Daily Dermal Exposure[f] (mg/day)	Daily Inhalation Exposure[g] (mg/day)
Applicator Exposure							
Applying Sprays with a Fixed-Wing Aircraft (3)	No Data See Eng. Control	No Data See Eng. Control	1 lb ai/acre	Ag	350 acres	See Eng. C.	See Eng. C.
			0.5 lb ai/acre			See Eng. C.	See Eng. C.
Applying Granulars with a Fixed-Wing Aircraft (4)	No Data See Eng. Control	No Data See Eng. Control	2 lb ai/acre	Ag	350 acres	See Eng. C.	See Eng. C.
			1 lb ai/acre			See Eng. C.	See Eng. C.
			0.75 lb ai/acre (proposed)			See Eng. C.	See Eng. C.
Applying Sprays with a Helicopter (5)	See fixed-wing aircraft	See fixed-wing aircraft	1 lb ai/acre	Ag	350 acres	See fixed-wing aircraft	See fixed-wing aircraft
			0.5 lb ai/acre				
Applying Granulars with a Helicopter (6)	No Data	No Data	2 lb ai/acre	Ag	350 acres	No data	No data
			1 lb ai/acre				
			0.75 lb ai/acre (proposed)				
Applying Sprays with a Groundboom (7)	0.014	0.74	4 lb ai/acre	Ag	80 acres	4.5	0.24
			1 lb ai/acre			1.1	0.059
			0.5 lb ai/acre			0.56	0.03
Applying Sprays to Orchards with an Airblast (8)	0.36	4.5	3 lb ai/acre	Ag	40 acres	43	0.54
Applying Granulars with a Tractor-Drawn Spreader (9)	0.0099	1.2	8 lb ai/acre	Ag	80 acres	6.3	0.77
			4 lb ai/acre			3.2	0.38
			1 lb ai/acre			0.79	0.096
			0.75 lb ai/acre (proposed)			0.59	0.072
			3 lb ai/acre[h]	Nut Trees	2 acres	0.059	0.0072
			102 lb ai/acre[h]	Non-Bearing Fruit Trees		2.0	0.24
			28.6 lb ai/acre	Flowers/Groundcover		0.57	0.069

Table 4. Occupational Handler Dermal and Inhalation Exposures to Disulfoton at Baseline (Continued)

Exposure Scenario (Scenario #)	Baseline Dermal Unit Exposure[a] (mg/lb ai)	Baseline Inhalation Unit Exposure[b] (g/lb ai)	Range of Application Rates[c] (lb ai/acre)	Crop Type or Target[d]	Amount Handled per Day[e]	Daily Dermal Exposure[f] (mg/day)	Daily Inhalation Exposure[g] (mg/day)
Mixer/Loader/Applicator Exposure							
Loading/Applying Granulars Using a Belly Grinder (10)	10	62	4 lb ai/acre	Ag	2 acres	80	0.50
			1 lb ai/acre			20	0.12
			28.6 lb ai/acre	Flowers/Groundcover	2 acres	570	3.5
Loading/Applying Granulars with a Push-Type Granular Spreader (11)	2.9	6.3	3 lb ai/acre	Nut Trees	2 acres	17	0.038
			102 lb ai/acre[h]	Non-Bearing Fruit Trees		590	1.3
			20 lb ai/acre[i]	Shrubs/Trees (inc. Christmas Trees)		120	0.25
			4.3 lb ai/acre[j]			25	0.054
			4 lb ai/acre	Ag	2 acres	23	0.050
			1 lb ai/acre			5.8	0.013
			28.6 lb ai/acre	Flowers/Groundcover	2 acres	170	0.36
Loading/Applying Granulars by Hand, with a Spoon, Shaker Can, or a Measuring Scoop (12)	100	470	0.00052 lb ai/12-inch pot	Potted Plants	350 pots	18	0.086
Applying Ready-To-Use Liquid as a Seed Treatment (13)	No Data	No Data	No Data	No Data	No Data	No Data	No Data
Flagger Exposure							
Flagging Aerial Spray Applications (14)	0.011	0.35	1 lb ai/acre	Ag	350 acres	3.9	0.12
			0.5 lb ai/acre			1.9	0.061
Flagging Aerial Granular Applications (15)	0.0028	0.15	2 lb ai/acre	Ag	350 acres	2.0	0.11
			1 lb ai/acre			0.98	0.053
			0.75 lb ai/acre (proposed)			0.74	0.039

Footnotes:

Table 4. Occupational Handler Dermal and Inhalation Exposures to Disulfoton at Baseline (Continued)

a Baseline Dermal Unit Exposure values are taken from PHED (V1.1), and represent long pants, long sleeved shirt, no gloves, open mixing/loading, and open cab tractors, as appropriate. Open cockpit data are not available.

b Baseline Inhalation Unit Exposure values are taken from PHED (V1.1), and reflect no respiratory protection.

c Application rates come from values found on disulfoton labels. The rates chosen for assessment are meant to bracket the rates on the labels. The following rates appear on the current EPA approved labels. Proposed changes to labels 3125-172 and 3125-307 are identified in the following list:

Scenario 1a: 3.0 lb/A (chemigation) -- current: poplars (pulp), potatoes, tomatoes; **proposed**: no tomatoes
2.0 lb/A (chemigation) -- current: lettuce
1.0 lb/A (aerial/chemigation) -- current: barley, brussel sprouts, cauliflower, corn (field, pop), cotton, pecans, potatoes, wheat; **proposed**: no corn, no pecans
0.75 lb/A (aerial) -- current: oats, triticale, wheat; **proposed**: no oats
0.56 lb/A (aerial) -- current: cotton; **proposed**: no cotton
0.5 lb/A (aerial) -- current: sorghum

Scenario 1b: 4.0 lb/A -- current: potatoes, tobacco, strawberries (nonbearing); **proposed**: no potatoes
3.0 lb/A -- current: pecans, tomatoes; **proposed**: no pecans, no tomatoes
2.5 lb/A -- current: beans, lentils
2.0 lb/A -- current: beans, cabbage, cotton, lettuce, peppers, radish (seed); **proposed**: no cotton
1.0 lb/A -- current: asparagus, barley, Bermudagrass (seed), broccoli, brussel sprouts, cauliflower, corn (field, pop), cotton, potatoes, sorghum, wheat; **proposed**: no corn
0.75 lb/A -- current: triticale, wheat
0.56 lb/A -- current: cotton; **proposed**: no cotton
0.5 lb/A -- current: oats, sorghum; **proposed**: no oats

Scenario 2a, 4, 6,15: 2 lb ai/acre -- current: cotton
1 lb ai/acre -- current -- barley, wheat, **proposed**: cotton
0.75 lb ai/acre -- **proposed**: wheat

Scenario 2b and 9: 102 lb ai/acre -- current: non-bearing fruit trees
28.6 lb ai/acre -- current: flowers and groundcover
8.0 lb ai/acre -- current: raspberries
4 lb ai/acre -- current: potatoes , tobacco and **proposed** reduction in potato rate
3 lb ai/acre -- current: pecans trees, **proposed**: no potatoes and pecan trees
2.5 lb lb ai/acre -- current: peas, lentils
2.0 lb ai/acre -- current: beans, cotton, lettuce, peanuts, peppers, tomatoes , **proposed**: no tomatoes and reduction in rates for beans and peanuts
1.5 lb ai/acre -- current: cabbage
1.0 lb ai/acre -- current: alfalfa, barley, cotton, sorghum, wheat, sugar beets, spinach, broccoli, brussel sprouts, cauliflower, and **proposed**: beans, and peanuts and reduction in rates for wheat
0.75 lb ai/acre -- **proposed**: wheat

Scenario 10 28.6 lb ai/acre: current: flowers and groundcover
4 lb ai/acre -- current: strawberries, potatoes, tobacco; **proposed** reduction in potato rate
2.5 lb lb ai/acre -- current: peas, lentil
2.0 lb ai/acre -- current: beans, cotton, lettuce, peanuts, peppers, tomatoes , **proposed**: no tomatoes and reduction in beans, peanuts
1.5 lb ai/acre -- current: cabbage
1.0 lb ai/acre -- current: sugar beets, spinach, broccoli, brussel sprouts, cauliflower, and **proposed**: beans and peanuts

Scenario ll: 102 lb ai/acre -- current: non-bearing fruit trees
28.6 lb ai/acre -- current : flowers and groundcover
20 lb ai/acre -- current: shrubs and trees including Christmas trees
4.3 lb ai/acre -- current : shrubs and trees including Christmas tree
4 lb ai/acre -- current: strawberries, potatoes, tobacco; **proposed** reduction in potato rate

Table 4. Occupational Handler Dermal and Inhalation Exposures to Disulfoton at Baseline (Continued)

2.5 lb lb ai/acre -- current: peas, lentils
2.0 lb ai/acre -- current: beans, cotton, lettuce, peanuts, peppers, tomatoes , **proposed**: no tomatoes, and reduction in rates for beans and peanuts
1.5 lb ai/acre -- current: cabbage
1.0 lb ai/acre -- current: sugar beets, spinach, broccoli, brussel sprouts, cauliflower, and **proposed**: beans, and peanuts

Scenario 12: 0.00052 lb ai/12 inch pot -- current: potted plants

d Crop Type or Target provides a general description of the intended uses of various products containing disulfoton. Separate categories are presented because of differences in application rates and acres treated.

e Amount Handled Per Day values are from default estimates of acreage treated, or number of pots handled in a single day for each exposure scenario of concern, based on the application method.

f Daily Dermal Exposure (mg/day) = Dermal Unit Exposure (mg/lb ai) * Application Rate (lb ai/acre) * Amount Handled Per Day (acres/day).

g Daily Inhalation Exposure (mg/day) = Inhalation Unit Exposure (µg/lb ai) * (1 mg/1000 µg) Conversion * Application Rate (lb ai/acre) * Amount Handled Per Day (acres/day).

h Application rates for trees are based on planting with 10-foot centers, which is equivalent to 435 trees/acre.

I Shrubs/trees application rate is calculated on an estimates of 2-inch trunk diameter when measured 4-feet from the ground. The plantings use a 10-foot center planting which corresponds to 435 trees/shrubs per acre.

j This application rate is for coffee trees estimated to be 8-feet in height, planted with 10-foot centers.

Table 5. Occupational Handler Short-term and Intermediate-term Risks from Disulfoton at Baseline

Exposure Scenario (Scenario. #)	Crop Type or Target[a]	Application Rate (lb ai/acre)[b]	Amount Handled per Day[c]	Baseline Dermal			Baseline Inhalation		Baseline Total	
				Daily Dose (mg/kg/day)[d]	Short-term MOE[e]	Int.-term MOE[f]	Daily Dose (mg/kg/day)[g]	MOE[h]	Short-term MOE[i]	Int.-term MOE[j]
Mixer/Loader Risk										
Mixing/Loading Liquid Formulations (Emulsifiable Concentrates) for Aerial/ Chemigation Application (1a)	Ag	3 chemigation only	350 acres	44	0.009	0.002	0.018	2.5	0.009	0.002
		1		15	0.03	0.006	0.0060	7.5	0.03	0.006
		0.5		7.3	0.06	0.01	0.0030	15	0.06	0.01
Mixing/Loading Liquid Formulations (Emulsifiable Concentrates) for Ground-boom Application(1b)	Ag	4	80 acres	13	0.03	0.006	0.0055	8.2	0.03	0.006
		1		3.3	0.1	0.03	0.0014	33	0.1	0.03
		0.5		1.7	0.2	0.05	0.00069	66	0.2	0.05
Mixing/Loading Liquid Formulations (Emulsifiable Concentrates) for Orchard Airblast Sprayer Application (1c)	Ag	3	40 acres	5.0	0.08	0.02	0.0021	22	0.08	0.02
Loading Granulars for Aerial Application (2a)	Ag	2	350 acres	0.084	4.8	1.0	0.017	2.7	1.7	0.7
		1		0.042	9.5	2.0	0.0085	5.3	3.4	1.4
		0.75 (proposed)		0.032	13	2.6	0.0064	7.1	4.5	1.9

Table 5. Occupational Handler Short-term and Intermediate-term Risks from Disulfoton at Baseline (Continued)

Exposure Scenario (Scenario. #)	Crop Type or Target[a]	Application Rate (lb ai/acre)[b]	Amount Handled per Day[c]	Baseline Dermal			Baseline Inhalation		Baseline Total	
				Daily Dose (mg/kg/day)[d]	Short-term MOE[e]	Int.-term MOE[f]	Daily Dose (mg/kg/day)[g]	MOE[h]	Short-term MOE[i]	Int.-term MOE[j]
oading Granulars for Tractor-Drawn Spreader Application (2b)	Ag	8	80 acres	0.077	5.2	1.1	0.016	2.9	1.9	0.8
		4		0.038	10	2.2	0.0078	5.8	3.7	1.6
		1		0.0096	42	8.7	0.0019	23	15	6.3
		0.75 (proposed)		0.0072	56	12	0.0015	31	20	8.4
	Nut Trees	3	2 acres	0.00072	560	120	0.00015	300	200	84
	Non-Bearing Fruit Trees	102		0.024	16	3.4	0.0050	9.1	5.8	2.5
	Flowers/ Groundcover	28.6		0.0069	58	12	0.0014	32	21	8.8
Applicator Risk										
Applying Sprays with a Fixed-Wing Aircraft (3)	Ag	1	350 acres	No Data See Eng. Cont.	No Data See Eng. Cont.	No Data See Eng. Cont.	No Data See Eng. Cont.	No Data See Eng. Cont.	No Data See Eng. Cont.	No Data See Eng. Cont.
		0.5								
Applying Granulars with a Fixed-Wing Aircraft (4)	Ag	2	350 acres	No Data See Eng. Cont.	No Data See Eng. Cont.	No Data See Eng. Cont.	No Data See Eng. Cont.	No Data See Eng. Cont.	No Data See Eng. Cont.	No Data See Eng. Cont.
		1								
		0.75 (proposed)								
Applying Sprays with a Helicopter (5)	Ag	1	350 acres	See fixed-wing aircraft.	See fixed-wing aircraft.	See fixed-wing aircraft.	See fixed-wing aircraft.	See fixed-wing aircraft.	See fixed-wing aircraft.	See fixed-wing aircraft.
		0.5								
Applying Granulars with a Helicopter (6)	Ag	2	350 acres	No Data	No Data	No Data	No Data	No Data	No Data	No Data
		1								
		0.75 (proposed)								

Table 5. Occupational Handler Short-term and Intermediate-term Risks from Disulfoton at Baseline (Continued)

Exposure Scenario (Scenario. #)	Crop Type or Target[a]	Application Rate (lb ai/acre)[b]	Amount Handled per Day[c]	Baseline Dermal			Baseline Inhalation		Baseline Total	
				Daily Dose (mg/kg/day)[d]	Short-term MOE[e]	Int.-term MOE[f]	Daily Dose (mg/kg/day)[g]	MOE[h]	Short-term MOE[i]	Int.-term MOE[j]
Applying Sprays with a Groundboom (7)	Ag	4	80 acres	0.064	6.3	1.3	0.0034	13	4.3	1.2
		1		0.016	25	5.2	0.00085	53	17	4.7
		0.5		0.0080	50	10	0.00042	110	34	9.5
Applying Sprays to Orchards with an Airblast (8)	Ag	3	40 acres	0.62	0.6	0.1	0.0077	5.8	0.6	0.1
Applying Granulars with a Tractor-Drawn Spreader (9)	Ag	8	80 acres	0.091	4.4	0.9	0.011	4.1	2.1	0.8
		4		0.045	8.8	1.8	0.0055	8.2	4.3	1.5
		1		0.011	35	7.4	0.0014	33	17	6.0
		0.75 (proposed)		0.0085	47	9.8	0.0010	44	23	8.0
	Nut Trees	3	2 acres	0.00085	470	98	0.00010	440	230	80
	Non-Bearing Fruit Trees	102		0.029	14	2.9	0.0035	13	6.7	2.4
	Flowers/ Groundcover	28.6		0.0081	49	10	0.00098	46	24	8.4
Mixer/Loader/Applicator Risk										
Loading/Applying Granulars Using a Belly Grinder (10)	Ag	4	2 acres	1.1	0.4	0.07	0.0071	6.4	0.3	0.07
		1		0.29	1.4	0.3	0.0018	25	1.3	0.3
	Flowers/ Groundcover	28.6	2 acres	8.2	0.05	0.01	0.051	0.9	0.05	0.01

Table 5. Occupational Handler Short-term and Intermediate-term Risks from Disulfoton at Baseline (Continued)

Exposure Scenario (Scenario. #)	Crop Type or Target[a]	Application Rate (lb ai/acre)[b]	Amount Handled per Day[c]	Baseline Dermal			Baseline Inhalation		Baseline Total	
				Daily Dose (mg/kg/day)[d]	Short-term MOE[e]	Int.-term MOE[f]	Daily Dose (mg/kg/day)[g]	MOE[h]	Short-term MOE[i]	Int.-term MOE[j]
Loading/Applying Granulars with a Push-Type Granular Spreader (11)	Nut Trees	3	2 acres	0.25	1.6	0.3	0.00054	83	1.6	0.3
	Non-Bearing Fruit Trees	102		8.5	0.05	0.01	0.018	2.5	0.05	0.01
	Shrubs/Trees (inc. Christmas Trees)	20		1.7	0.2	0.05	0.0036	13	0.2	0.05
		4.3		0.36	1.1	0.2	0.00077	58	1.1	0.2
	Ag	4	2 acres	0.33	1.2	0.3	0.00072	63	1.2	0.3
		1		0.083	4.8	1.0	0.00018	250	4.7	1.0
	Flowers/ Groundcover	28.6	2 acres	2.4	0.2	0.04	0.0051	8.7	0.2	0.04
Loading/Applying Granulars by Hand, with a Spoon, Shaker Can, or a Measuring Scoop (12)[m]	Potted Plants	0.00052 lb ai/12 inch pot	350 pots	0.26	1.5	0.3	0.0012	37	1.5	0.3
Applying Ready-to-Use Liquid as a Seed Treatment (13)	Ag (Cotton)	No Data	No Data	No Data	No Data	No Data	No Data	No Data	No Data	No Data
Flagger Risk										
Flagging Aerial Spray Applications (14)	Ag	1	350 acres	0.055	7.3	1.5	0.0018	26	5.7	1.4
		0.5		0.028	15	3.0	0.00088	51	11	2.9
Flagging Aerial Granular Applications (15)	Ag	2	350 acres	0.028	14	3.0	0.0015	30	9.7	2.7
		1		0.014	29	6.0	0.00075	60	19	5.4
		0.75 (proposed)		0.011	38	7.9	0.00056	80	26	7.2

Footnotes:

a Crop Type or Target provides a general description of the intended uses of various products containing disulfoton. Separate categories are presented because of the distinct differences in application rates and acres treated.

b Application rates assessed are designed to bracket the rates found on current and proposed disulfoton labels. (See footnote c Table 4 for specifics).

c Amount Handled Per Day values are from default estimates of acreage treated, or number of pots handled in a single day for each exposure scenario of concern, based on the application method.

d Baseline Daily Dermal Dose (mg/kg/day) = Daily Dermal Exposure (mg/day) / Body Weight (70 kg).

Table 5. Occupational Handler Short-term and Intermediate-term Risks from Disulfoton at Baseline (Continued)

e Baseline Dermal Short-term MOE = NOAEL (0.4 mg/kg/day) / Baseline Daily Dermal Dose (mg/kg/day).
f Baseline Dermal Intermediate-term MOE = NOAEL (0.03 mg/kg/day) / [Baseline Daily Dermal Dose (mg/kg/day) * 0.36 Dermal Absorption Factor].
g Baseline Daily Inhalation Dose (mg/kg/day) = Daily Inhalation Exposure (mg/day) / Body Weight (70 kg)).
h Inhalation MOE = NOAEL (0.045 mg/kg/day) / Baseline Daily Inhalation Dose (mg/kg/day).
I Total Short-term MOE = 1/[(1/Short-term Dermal MOE) + (1/Inhalation MOE)].
j Total Intermediate-term MOE = 1/[(1/Intermediate-term Dermal MOE) + (1/Inhalation MOE)].

Table 6. Occupational Handler Short-term and Intermediate-term Risks from Disulfoton with Additional PPE

Exposure Scenario (Scenario. #)	Crop Type or Target[a]	Application Rate (lb ai/acre)	Amount Handled per Day[b]	Dermal - Additional PPE[c]				Inhalation - Additional PPE[d]			Total - Additional PPE	
				Unit Exposure (mg/lb ai)	Daily Dose (mg/kg/day)[e]	Short-term MOE[f]	Int.-term MOE[g]	Unit Exposure (g/lb ai)	Daily Dose (mg/kg/day)[h]	MOE[i]	Short-term MOE[j]	Int.-term MOE[k]
Mixer/Loader Risk												
Mixing/Loading Liquid Formulations (Emulsifiable Concentrates) for Aerial/ Chemigation Application (1a)	Ag	chemigation only 3	350 acres	0.017	0.26	1.6	0.3	0.24	0.0036	13	1.4	0.3
		1			0.085	4.7	1.0		0.0012	38	4.2	1.0
		0.5			0.043	9.4	2.0		0.00060	75	8.4	1.9
Mixing/Loading Liquid Formulations (Emulsifiable Concentrates) for Ground-boom Application(1b)	Ag)	4	80 acres	0.017	0.078	5.1	1.1	0.24	0.0011	41	4.6	1.0
		1			0.019	21	4.3		0.00027	160	18	4.2
		0.5			0.0097	41	8.6		0.00014	330	37	8.4
Mixing/Loading Liquid Formulations (Emulsifiable Concentrates) for Orchard Airblast Sprayer Application (1c)	Ag	3	40 acres	0.017	0.029	14	2.9	0.24	0.00041	110	12	2.8
Loading Granulars for Aerial Application (2a)	Ag	2	350 acres	0.0034	0.034	12	2.5	0.34	0.0034	13	6.2	2.1
		1			0.017	24	4.9		0.0017	26	12	4.1
		0.75 (proposed)			0.013	31	6.5		0.0013	35	17	5.5

Table 6. Occupational Handler Short-term and Intermediate-term Risks from Disulfoton with Additional PPE (Continued)

Exposure Scenario (Scenario. #)	Crop Type or Target[a]	Application Rate (lb ai/acre)	Amount Handled per Day[b]	Dermal - Additional PPE[c]				Inhalation - Additional PPE[d]			Total - Additional PPE	
				Unit Exposure (mg/lb ai)	Daily Dose (mg/kg/day)[e]	Short-term MOE[f]	Int.-term MOE[g]	Unit Exposure (g/lb ai)	Daily Dose (mg/kg/day)[h]	MOE[i]	Short-term MOE[j]	Int.-term MOE[k]
Loading Granulars for Tractor-Drawn Spreader Application (2b)	Ag	8	80 acres	0.0034	0.031	13	2.7	0.34	0.0031	14	6.9	2.3
		4			0.016	26	5.4		0.0016	29	14	4.5
		1			0.0039	100	21		0.00039	120	54	18
		0.75 (proposed)			0.0029	140	29		0.00029	150	73	24
	Nut Trees	3	2 acres		0.00029	NA	290		0.000029	1,600	NA	240
	Non-Bearing Fruit Trees	102			0.0099	40	8.4		0.00099	45	21	7.1
	Flowers/ Groundcover	28.6			0.0028	140	30		0.00028	160	76	25
Applicator Risk												
Applying Sprays with a Fixed-Wing Aircraft (3)	Ag	1	350 acres	No Data See Eng. Con.	No Data See Eng. Con.	No Data See Eng. Con.	No Data See Eng. Con.	No Data See Eng. Con.	No Data See Eng. Con.	No Data See Eng. Con.	No Data See Eng. Con.	No Data See Eng. Con.
		0.5										
Applying Granulars with a Fixed-Wing Aircraft (4)	Ag	2	350 acres	No Data See Eng. Con.	No Data See Eng. Con.	No Data See Eng. Con.	No Data See Eng. Con.	No Data See Eng. Con.	No Data See Eng. Con.	No Data See Eng. Con.	No Data See Eng. Con.	No Data See Eng. Con.
		1										
		0.75 (proposed)										
Applying Sprays with a Helicopter (5)	Ag	1	350 acres	See fixed-wing aircraft.	See fixed-wing aircraft.	See fixed-wing aircraft.	See fixed-wing aircraft.	See fixed-wing aircraft.	See fixed-wing aircraft.	See fixed-wing aircraft.	See fixed-wing aircraft.	See fixed-wing aircraft.
		0.5										
Applying Granulars with a Helicopter (6)	Ag	2	350 acres	No Data	No Data	No Data	No Data	No Data	No Data	No Data	No Data	No Data

Table 6. Occupational Handler Short-term and Intermediate-term Risks from Disulfoton with Additional PPE (Continued)

Exposure Scenario (Scenario. #)	Crop Type or Target[a]	Application Rate (lb ai/acre)	Amount Handled per Day[b]	Dermal - Additional PPE[c]				Inhalation - Additional PPE[d]			Total - Additional PPE	
				Unit Exposure (mg/lb ai)	Daily Dose (mg/kg/day)[e]	Short-term MOE[f]	Int.-term MOE[g]	Unit Exposure (g/lb ai)	Daily Dose (mg/kg/day)[h]	MOE[i]	Short-term MOE[j]	Int.-term MOE[k]
		1										
		0.75 (proposed)										
Applying Sprays with a Groundboom (7)	Ag	4	80 acres	0.011	0.05	8.0	1.7	0.15	0.00069	66	7.1	1.6
		1			0.013	32	6.6		0.00017	260	28	6.5
		0.5			0.0063	64	13		0.000086	530	57	13
Applying Sprays to Orchards with an Airblast (8)	Ag	3.0	40 acres	0.22	0.38	1.1	0.2	0.90	0.0015	29	1.0	0.2
Applying Granulars with a Tractor-Drawn Spreader (9)	Ag	8	80 acres	0.0042	0.038	10	2.2	0.24	0.0022	21	6.9	2.0
		4			0.019	21	4.3		0.0011	41	14	3.9
		1			0.0048	83	17		0.00027	160	55	16
		0.75 (proposed)			0.0036	110	23		0.00021	220	74	21
	Nut Trees	3	2 acres	0.0042	0.00036	NA	230	0.24	0.000021	2,200	NA	210
	Non-Bearing Fruit Trees	102			0.012	33	6.8		0.00070	64	22	6.2
	Flowers/ Groundcover	28.6			0.0034	120	24		0.00020	230	77	22
Mixer/Loader/Applicator Risk												
Loading/Applying Granulars Using a Belly Grinder (10)	Ag	4	2 acres	17	1.9	0.2	0.04	12	0.0014	33	0.2	0.04
		1			0.49	0.8	0.2		0.00034	130	0.8	0.2
	Flowers/ Groundcover	28.6	2 acres		14	0.03	0.006		0.0098	4.6	0.03	0.006

Table 6. Occupational Handler Short-term and Intermediate-term Risks from Disulfoton with Additional PPE (Continued)

Exposure Scenario (Scenario. #)	Crop Type or Target[a]	Application Rate (lb ai/acre)	Amount Handled per Day[b]	Dermal - Additional PPE[c]				Inhalation - Additional PPE[d]			Total - Additional PPE	
				Unit Exposure (mg/lb ai)	Daily Dose (mg/kg/day)[e]	Short-term MOE[f]	Int.-term MOE[g]	Unit Exposure (g/lb ai)	Daily Dose (mg/kg/day)[h]	MOE[i]	Short-term MOE[j]	Int.-term MOE[k]
Loading/Applying Granulars with a Push-Type Granular Spreader (11)	Nut Trees	3	2 acres	0.73	0.063	6.4	1.3	1.3	0.00011	400	6.3	1.3
	Non-Bearing Fruit Trees	102			2.1	0.2	0.04		0.0038	12	0.2	0.04
	Shrubs/Trees (inc. Christmas Trees)	20			0.42	1.0	0.2		0.00074	61	0.9	0.2
		4.3			0.090	4.5	0.9		0.00016	280	4.4	0.9
	Ag	4	2 acres		0.083	4.8	1.0		0.00015	300	4.7	1.0
		1			0.021	19	4.0		0.000037	1,200	19	4.0
	Flowers/ Groundcover	28.6	2 acres		0.60	0.7	0.1		0.0011	42	0.7	0.1
Loading/Applying Granulars by Hand, with a Spoon, Shaker Can, or a Measuring Scoop (12)	Potted Plants	0.00052 lb ai/12 inch pot	350 pots	40[l]	0.10	3.8	0.8	47 ov resp[l,m]	0.00012	370	3.8	0.8
								94 dm mask[l,m]	0.00024	180	3.8	0.8
Applying Ready-to-Use Liquid as a Seed Treatment (13)	Ag	No Data	No Data	No Data	No Data	No Data	No Data	No Data	No Data	No Data	No Data	No Data
Flagger Risk												
Flagging Aerial Spray Applications (14)	Ag	1	350 acres	0.010	0.050	8	1.7	0.070	0.00035	130	7.5	1.6
		0.5			0.025	16	3.3		0.00018	260	15	3.3
Flagging Aerial Granular Applications (15)	Ag	2	350 acres	0.0016	0.016	25	5.2	0.030	0.00030	150	21	5.0
		1			0.0080	50	10		0.00015	300	43	10
		0.75 (proposed)			0.0060	67	14		0.00011	400	55	16

Table 6. Occupational Handler Short-term and Intermediate-term Risks from Disulfoton with Additional PPE (Continued)

Note: Assessed application rates are designed to bracket the rates found on current and proposed disulfoton labels. For specifics, see footnote c on Table 4.

Footnotes:

[a] Crop Type or Target provides a general description of the intended uses of various products containing disulfoton. Separate categories are presented because of the distinct differences in application rates and acres treated.

[b] Amount Handled Per Day values are from default estimates of acreage treated, or number of pots handled in a single day for each exposure scenario of concern, based on the application method.

[c] Additional PPE for all scenarios includes double layer of clothing (50% PF for clothing, except scenario 2, for which double layer data were available), and chemical resistant gloves. Flagger exposure values (scenarios 14 and 15 are based on double layer of clothing and no gloves).

[d] Additional PPE represents dust/mist respirator (5-fold PF), except for indoor application of scenario 12, which labels state use an OV respirator (10-fold PF). See footnote m below.

[e] Daily Dermal Dose (mg/kg/day) = Daily Dermal Exposure (mg/day)/ Body weight (70 kg).

[f] Short-term Dermal MOE = NOAEL (0.4 mg/kg/day)/ Daily Dermal Dose (mg/kg/day).

[g] Intermediate-term Dermal MOE = NOAEL (0.03 mg/kg/day)/Absorbed Daily Dermal Dose (mg/kg/day). Absorbed Dermal Dose = Daily Dermal Dose * 0.36 Dermal Absorption Factor.

[h] Daily Inhalation Dose (mg/kg/day) = Daily Inhalation Exposure (mg/day)/ Body weight (70 kg).

[I] Inhalation MOE = NOAEL (0.045 mg/kg/day)/ Daily Inhalation Dose (mg/kg/day).

[j] Total Short-term MOE = 1/ [(1/ Short-term Dermal MOE) + (1/ Inhalation MOE)].

[k] Total Intermediate-term MOE = 1/ ((1/ Intermediate-term Dermal MOE) + (1/Inhalation MOE)).

[l] Unit exposure data for application of granules by hand were used as surrogate values for these scenarios.

[m] Disulfoton labels require use of an OV respirator (10-Fold PF) for indoor applications, and use of dust mist respirator for outdoor applications.

Table 7. Occupational Handler Short-term and Intermediate-term Risks from Disulfoton with Engineering Controls

Exposure Scenario (Scenario. #)	Crop Type or Target[a]	Application Rate (lb ai/acre)[b]	Amount Handled per Day[c]	Dermal - Engineering Controls[d]				Inhalation - Engineering Controls[d]			Total - Engineering Controls	
				Unit Exposure (mg/lb ai)[e]	Daily Dose (mg/kg/day)[f]	Short-term MOE[g]	Int.-term MOE[h]	Unit Exposure (g/lb ai)[e]	Daily Dose (mg/kg/day)[f]	MOE[i]	Short-term MOE[j]	Int.-term MOE[k]
Mixer/Loader Risk												
Mixing/Loading Liquid Formulations (Emulsifiable Concentrates) for Aerial/ Chemigation Application (1a)	Ag	chemigation only 3	350 acres	0.0086	0.13	3.1	0.6	0.083	0.0012	36	2.9	0.6
		1			0.043	9.3	1.9		0.00042	110	8.6	1.9
		0.5			0.022	19	3.9		0.00021	220	17	3.8
Mixing/Loading Liquid Formulations (Emulsifiable Concentrates) for Ground-boom Application(1b)	Ag	4	80 acres	0.0086	0.039	10	2.1	0.083	0.00038	120	9.4	2.1
		1			0.0098	41	8.5		0.000095	470	37	8.3
		0.5			0.0049	81	17		0.000047	950	75	17
Mixing/Loading Liquid Formulations (Emulsifiable Concentrates) for Orchard Airblast Sprayer Application (1c)	Ag	3	40 acres	0.0086	0.015	27	5.7	0.083	0.00014	320	25	5.6
Loading Granulars for Aerial Application (2a)	Ag	2	350 acres	0.00017	0.0017	240	49	0.034	0.00034	130	85	36
		1			0.00085	470	98		0.00017	260	170	72
		0.75 (proposed)			0.00064	630	130		0.00013	350	230	95

Table 7. Occupational Handler Short-term and Intermediate-term Risks from Disulfoton with Engineering Controls (Continued)

Exposure Scenario (Scenario. #)	Crop Type or Target[a]	Application Rate (lb ai/acre)[b]	Amount Handled per Day[c]	Dermal - Engineering Controls[d]				Inhalation - Engineering Controls[d]			Total - Engineering Controls	
				Unit Exposure (mg/lb ai)[e]	Daily Dose (mg/kg/day)[f]	Short-term MOE[g]	Int.-term MOE[h]	Unit Exposure (g/lb ai)[e]	Daily Dose (mg/kg/day)[f]	MOE[i]	Short-term MOE[j]	Int.-term MOE[k]
Loading Granulars for Tractor-Drawn Spreader Application (2b)	Ag	8	80 acres	0.00017	0.0016	260	54	0.034	0.00031	140	93	39
		4			0.00078	510	110		0.00016	290	190	78
		1			0.00019	2,100	430		0.000039	1,200	740	310
		0.75 (proposed)			0.00015	2,700	570		0.000029	1,500	990	420
	Nut Trees	3	2 acres		NA	NA	NA		NA	NA	NA	NA
	Non-Bearing Fruit Trees	102			0.00050	810	170		0.000099	450	290	120
	Flowers/ Groundcover	28.6			0.00014	2,900	600		0.000028	1,600	1,000	440
Applicator Risk												
Applying Sprays with a Fixed-Wing Aircraft (3)	Ag	1	350 acres	0.0050	0.025	16	3.3	0.068	0.00034	130	14	3.3
		0.5			0.013	32	6.7		0.00017	260	29	6.5
Applying Granulars with a Fixed-Wing Aircraft (4)	Ag	2	350 acres	0.0017	0.017	24	4.9	1.3	0.013	3.5	3.0	2.0
		1			0.0085	47	9.8		0.0065	6.9	6.0	4.1
		0.75 (proposed)			0.0064	63	13		0.0049	9.2	8.0	5.4
Applying Sprays with a Helicopter (5)	Ag	1	350 acres		See fixed-wing aircraft.	See fixed-wing aircraft.	See fixed-wing aircraft.	See fixed-wing aircraft.	See fixed-wing aircraft.	See fixed-wing aircraft.	See fixed-wing aircraft.	See fixed-wing aircraft.
		0.5										
Applying Granulars with a Helicopter (6)	Ag	2	350 acres		No Data	No Data	No Data	No Data	No Data	No Data	No Data	No Data
		1										
		0.75 (proposed)										
Applying Sprays with a Groundboom (7)	Ag	4	80 acres	0.0050	0.023	18	3.6	0.043	0.00020	230	16	3.6
		1			0.0057	70	15		0.000049	920	65	14

Table 7. Occupational Handler Short-term and Intermediate-term Risks from Disulfoton with Engineering Controls (Continued)

Exposure Scenario (Scenario. #)	Crop Type or Target[a]	Application Rate (lb ai/acre)[b]	Amount Handled per Day[c]	Dermal - Engineering Controls[d]				Inhalation - Engineering Controls[d]			Total - Engineering Controls	
				Unit Exposure (mg/lb ai)[e]	Daily Dose (mg/kg/day)[f]	Short-term MOE[g]	Int.-term MOE[h]	Unit Exposure (g/lb ai)[e]	Daily Dose (mg/kg/day)[f]	MOE[i]	Short-term MOE[j]	Int.-term MOE[k]
		0.5			0.0029	140	29		0.000025	1,800	130	29
Applying Sprays to Orchards with an Airblast (8)	Ag	3	40 acres	0.14	0.24	1.7	0.3	0.45	0.00077	58	1.6	0.4
Applying Granulars with a Tractor-Drawn Spreader (9)	Ag	8	80 acres	0.0021	0.019	21	4.3	0.22	0.0020	22	11	3.6
		4			0.0096	42	8.7		0.0010	45	22	7.3
		1			0.0024	170	35		0.00025	180	86	29
		0.75 (proposed)			0.0018	220	46		0.00019	240	115	39
	Nut Trees	3	2 acres		NA	NA	NA		NA	NA	NA	NA
	Non-Bearing Fruit Trees	102			0.0061	65	14		0.00064	70	33	11
	Flowers/ Groundcover	28.6			0.0017	230	49		0.00018	250	120	41
Mixer/Loader/Applicator Risk												
Loading/Applying Granulars Using a Belly Grinder (10)	Ag	4	2 acres	NA	NA	NA	NA	NA	NA	NA	NA	NA
		1										
	Flowers/ Groundcover	28.6	2 acres	NA	NA	NA	NA	NA	NA	NA	NA	NA

Table 7. Occupational Handler Short-term and Intermediate-term Risks from Disulfoton with Engineering Controls (Continued)

Exposure Scenario (Scenario. #)	Crop Type or Target[a]	Application Rate (lb ai/acre)[b]	Amount Handled per Day[c]	Dermal - Engineering Controls[d]				Inhalation - Engineering Controls[d]			Total - Engineering Controls	
				Unit Exposure (mg/lb ai)[e]	Daily Dose (mg/kg/day)[f]	Short-term MOE[g]	Int.-term MOE[h]	Unit Exposure (g/lb ai)[e]	Daily Dose (mg/kg/day)[f]	MOE[i]	Short-term MOE[j]	Int.-term MOE[k]
Loading/Applying Granulars with a Push-Type Granular Spreader (11)	Nut Trees	3	2 acres	NA	NA	NA	NA	NA	NA	NA	NA	NA
	Non-Bearing Fruit Trees	102		NA	NA	NA	NA	NA	NA	NA	NA	NA
	Shrubs/Trees (inc. Christmas Trees)	20		NA	NA	NA	NA	NA	NA	NA	NA	NA
		4.3										
	Ag	4	2 acres	NA	NA	NA	NA	NA	NA	NA	NA	NA
		1										
	Flowers/ Groundcover	28.6	2 acres	NA	NA	NA	NA	NA	NA	NA	NA	NA
Loading/Applying Granulars by Hand, with a Spoon, Shaker Can, or a Measuring Scoop (12)[m]	Potted Plants	0.00052 lb ai/12 inch pot	350 pots	NA	NA	NA	NA	NA	NA	NA	NA	NA
Applying Ready-to-Use Liquid as a Seed Treatment (13)	Ag	No Data	No Data	No Data	No Data	No Data	No Data	No Data	No Data	No Data	No Data	No Data
Flagger Risk												
Flagging Aerial Spray Applications (14)	Ag	1	350 acres	0.0050[l]	0.025	16	3.3	0.043	0.00022	210	15	3.3
		0.5			0.013	32	6.7		0.00011	420	30	6.6
Flagging Aerial Granular Applications (15)	Ag	2	350 acres	0.0021[m]	0.021	19	4.0	0.22	0.0022	20	9.9	3.3
		1			0.011	38	7.9		0.0011	41	20	6.6
		0.75 (proposed)			0.0079	51	11		0.00083	55	26	8.9

Footnotes:

NA = Not Applicable

a Crop Type or Target provides a general description of the intended uses of various products containing disulfoton. Separate categories are presented because of differences in application rates and acres treated.
b Assessed application rates are designed to bracket the current and proposed application rates found on the disulfoton labels. For specifics, see footnote "c" of Table 4.
c Amount Handled Per Day values are from default estimates of acreage treated, or number of pots handled in a single day for each exposure scenario of concern, based on the application method.
d Engineering Controls are: closed mixing and loading , single layer of clothing, and chemical resistant gloves (1a, b, c); Closed loading of granulars (2a, b); single layer of clothing, no gloves and enclosed cockpit or cab (3,4,5,6,7, 14, and 15)
e Unit Exposure Values = From PHED V1.1 dated May 1997.
f Daily Dose (mg/kg/day) = Daily Inhalation Exposure (mg/day)/ Body weight (70 kg).
g Short-term Dermal MOE = NOAEL (0.4 mg/kg/day)/ Daily Dermal Dose (mg/kg/day).
h Intermediate-term Dermal MOE = NOAEL (0.03 mg/kg/day)/ Absorbed Daily Dermal Dose (mg/kg/day), which is Daily Dermal Dose * 0.36 (dermal absorption factor).
I Inhalation MOE = NOAEL (0.045 mg/kg/day) / Daily Inhalation Dose.
j Total Short-term MOE = 1/ ((1/ Dermal MOE) + (1/ Inhalation MOE)).
k Total Intermediate-term MOE = 1/ ((1/ Dermal MOE) + (1/ Inhalation MOE)).
l Based on data for groundboom, enclosed cab.
m Based on data for granular drop type tractor-drawn spreader, enclosed cab.

Handler Exposure and Risk Estimates for Cancer

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

Handler Scenarios with Risk Concerns

The calculations of short-term risks indicate that **total short-term MOEs** are greater than 100 at **baseline** for **none** of the assessed exposure scenarios **except** the following:

- (2b) loading granulars with a tractor-drawn spreader to nut (pecan) trees assuming an application rate of 3 lb ai/acre, applied to 2 acres per day.

- (9) applying granulars with a tractor-drawn spreader to nut (pecan) trees assuming an application rate of 3 lb ai/acre, applied to 2 acres per day.

The calculations of intermediate-term risks indicate that **total intermediate-term MOEs** are greater than 100 at **baseline** for **none** of the assessed exposure scenarios.

The calculations of short-term risks indicate that **total short-term MOEs** are greater than 100 at **with additional PPE** for **no** additional scenarios other than those mentioned above.

The calculations of short-term and intermediate-term risks indicate that **total intermediate -term MOEs** are more than 100 at **with additional PPE** for **none** of the assessed exposure scenarios **except** the following:

- (2a) loading granulars with a tractor-drawn spreader to nut (pecan) trees assuming an application rate of 3 lb ai/acre, applied to 2 acres per day.

- (9) applying granulars with a tractor-drawn spreader to nut (pecan) trees assuming an application rate of 3 lb ai/acre, applied to 2 acres per day.

The calculations of **total short-term risks** indicate that MOEs are more than **100** with **engineering controls** (Table 6) for the following additional scenarios:

- (2a) loading granulars for aerial application using a 1.0 lb ai/acre application rate.

- (2b) loading granulars for tractor-drawn spreader application to agricultural crops at application rates of 1 lb ai/acre and 4 lb ai/acre. MOEs are greater than 100 also for loading of granulars for application to non-bearing fruit trees and to flowers and groundcovers using a tractor-drawn spreader.

- (7) applying with a groundboom to agricultural crops using an application rate of 0.5 lb ai/acre.

- (9) applying granulars with a tractor-drawn spreader to flowers and groundcover using an application rate of 28.6 lb ai/acre.

The calculations of **total intermediate-term risks** indicate that MOEs are more than **100** with **engineering controls** (Table 6) for the following:

- (2b) loading granulars for tractor-drawn spreader application to agricultural crops at application rate of 1 lb ai/acre. MOEs are greater than 100 also for loading of granulars for application to non-bearing fruit trees and to flowers and groundcovers using a tractor-drawn spreader.

Data Gaps

As noted below in the data gaps discussion, several of the exposure scenarios could not be assessed due to lack of PHED surrogate data.

Data Gaps

Data gaps exist for the following scenario:

- (6) - no PHED data exist for applying granulars from helicopters.

- (16) - no PHED data exist for applying ready-to-use liquid as a seed treatment.

Data Quality and Confidence in Assessment

Several issues must be considered when interpreting the occupational exposure risk assessment. These include:

- Several handler assessments were completed using “low quality” PHED data due to the lack of a more acceptable dataset.

- Several generic protection factors were used to calculate handler exposures. These protection factors have not been completely evaluated and accepted by HED.

- Factors used to calculate daily exposures to handlers (e.g., acres treated per day and gallons of liquid applied) are based on the best professional judgement, due to a lack of pertinent use data.

- Dr. Jill Sidebottom, Extension Forestry Specialist, provided additional information concerning the use/usage of granular disulfoton on Fraser fir Christmas trees in North Carolina. Her information indicates that applicators can handle up to 225 lbs ai of disulfoton per day. This indicates that the exposure and risk estimates presented in Tables 4 – 7 may substantially underestimate that actually occurring in this crop.

Chemical Studies Submitted in Support of Reregistration

MRID 422294-01

In support of the reregistration of disulfoton, Miles Inc. has submitted a study estimating handler exposures. The results were based on surrogate data derived from handler exposure studies of Terbufos, Baythroid, and Bayleton which are referenced in Table 8. Surrogate exposure estimates for foliar applications to agricultural crops were based on a study of exposure to triadimefon during ground spray applications to wheat. Exposure estimates for soil-applied granular application of disulfoton were based on a published study of exposures to terbufos during planting of corn. Surrogate exposure estimates for aerial applications of disulfoton to agricultural crops were based on a study of exposure to cyfluthrin during aerial application of Baythroid 2 insecticide to cotton.

Data from this study were not considered in estimating occupational handler doses and risks in this assessment. The application rates used in MRID 422294-01 are within the range of rates used in this assessment. The acreage treated per day values used in the Miles study are greater than default estimates typically used by EPA. A dermal NOAEL of 0.4 mg/kg/day, and an inhalation NOAEL of 0.045 mg/kg/day were used in this assessment, while a dermal NOAEL of 0.8 mg/kg/day, and an inhalation NOAEL of 0.069 mg/kg/day were used in the Miles study. The MOEs observed by the registrant (as shown in Table 8) were somewhat higher than those calculated in this assessment.

Table 8. MRID 422294-01 Results: Summary of Di-Syston® Exposure Estimates[a]

Worker Exposure Activity	Application Rate[b] (lb ai/acre)	Amount Handled per Day[c] (acres)	Dermal Exposure (Dose)[d] (g/kg/day)	Inhalation Exposure (Dose)[d] (g/kg/day)	Dermal Margin of Safety (MOE)[e]	Inhalation Margin of Safety[f]
Mixer/Loader/Applicator (in furrow planting)	0.625 (cotton)	100	6.3	1.25	127	56
	3.0 (potatoes)		30.0	6.0	27	12
Mixer/Loader (ground-rig boom)	0.625 (cotton)	100	67.5	0.38	12	184
	3.0 (potatoes)		135.0	0.75	6	93
Mixer/Loader (aerial)	0.5 (cereals & corn)	900	<103.5	<0.90	8	78
	1.0		207.0	1.8	>4	>39
Applicator (ground-rig boom)	0.625 (cotton)	100	73.7	0.38	11	184
	3.0 (potatoes)		147.5	0.75	5	93
Mixer/Loader/Applicator (ground-rig boom)	0.625 (cotton)	100	84.8	0.90	9	155
	3.0 (potatoes)		169.5	0.45	5	78
Applicator (aerial)	0.5 (cereals & corn)	900	<135.0	<0.90	6	78
	1.0		270.0	1.8	>3	>39
Flagger (aerial)	0.5 (cereals & corn)	900	<99.0	<0.90	8	78
	1.0		198.0	1.8	>4	>39

Table 8. MRID 422294-01 Results: Summary of Di-syston® Exposure Estimates (continued)

[a] Exposure estimates are presented in MRID #422294-01, and are based on the following studies:

1. Knarr, R.D. Applicator and Mixer/Loader Exposures to Triadimefon During Ground Spray Application of BAYLETON® 50 FD Fungicide to Wheat Fields. *Mills Inc. Report No. 96798*. (June 1988). *EPA MRID No. 40995921*.

2. Eberhart, D.C. Field Exposure Study: Aerial Applications of BAYTHROID® 2 on Cotton. *Miles Inc. Report No. 91768*. (March 1986). *EPA ACCESSION No. 263763*.

3. Devine, J.M.; Kinoshita, G.B.; Peterson, R.B.; Picard, G.L. Farm Worker Exposure to Terbufos [phosphorodithioc acid, s-(tert-budylthio) methyl O,O-diethyl ester] During Planting Operations of Corn. *Archives of Environmental Toxicology*. 15:113-119 (1986).

[b] Based on data from Miles, Inc. field research and marketing personnel.

[c] Based on data from Miles, Inc. field research and marketing personnel.

[d] The inhalation and dermal exposures in this study were calculated by assigning all non-detectable values a value equal to the analytical limit of detection.

[e] Based on a NOAEL of 800 g/kg/day. *Miles, Inc. Report #98347*.

[f] Based on a NOAEL of 69 g/kg/day. *Miles, Inc. Report #99648*.

Post-Application Exposures and Risks

Postapplication Exposure Scenarios, Data, and Assumptions:

Occupational Postapplication Exposure Scenarios and Assumptions

HED has determined that there are potential postapplication occupational exposures to individuals entering treated areas for the purpose of harvesting of nut trees (pecans); harvesting of low-growing field crops; weeding and scouting and other non-harvesting activities associated with low-growing field crops; and transplanting, harvesting, and pruning of ornamentals.

Based on these activities, four representative scenarios were evaluated using surrogate dislodgeable foliar residue data and assumptions about transfer of residues to the skin. The surrogate assessments presented in Tables 8 and 9 are based on the application rates recommended for field crops, nut trees and ornamentals on disulfoton labels, and assumptions regarding activity levels. These assumptions would be expected to bracket the reentry exposure levels anticipated from disulfoton use on these crop types. The four scenarios and assumptions addressed by the calculations are described below:

- Harvesting of nut trees (i.e., pecans);
- Harvesting activities of low growing field crops (e.g., peanuts, cotton, broccoli, cabbage);
- Non-harvesting reentry activity (scouting, hoeing, weeding) associated with applications to low growing field crops (e.g., peanuts, cotton);
- Pruning, transplanting, and bundling of flowers associated with applications to flowers, and ornamental shrub and trees.

Data Source Descriptions for Scenarios Considered

Chemical-specific postapplication exposure data have been submitted in support of the reregistration of disulfoton, however HED has found these studies to be unacceptable[5]. In lieu of these data, a surrogate rangefinder postapplication exposure assessment was conducted to determine potential occupational and residential postapplication risks from disulfoton. The intermediate term dermal toxicity value of 0.03 mg/kg/day was used to assess risks from disulfoton. A short-term dermal toxicity value of 0.4 mg/kg/day is also available for disulfoton. However, risks were evaluated for intermediate-term exposures as a conservative approach.

Chemical Studies (Postapplication)

MRID 405041-05 and MRID 404690-01

A reentry interval study was conducted to support the reregistration of disulfoton. The study evaluated dislodgeable residues of disulfoton on cotton and potatoes, and calculated reentry intervals (MRID 404690-01, and MRID 405041-05 (Note: MRID 405041-05 is the same as study submission MRID 404690-0, except that MRID 404690-0 has an attached research and development phone report from Mobay Chemical Corporation summarizing a meeting between EPA personnel and Mobay personnel on the subject of reentry protocols and dislodgeable residues). The disulfoton study was conducted as a subset of MRID 404681-01 - Reentry Intervals for Azinphos-methyl, Oxydemeton-methyl, Disulfoton, and Anilazine. MRID 404681-01 was reviewed by HED and found to be unacceptable under Subdivision K Pesticide Assessment Guidelines. The study contained the following deficiencies:[5]

- QA/QC data were inadequate in regard to field recovery, laboratory recovery (with the exception of lab recovery data for soil residues), and storage stability;
- Analytic methods used for analysis of leaf wash and soil samples were not specified;
- Chromatograms were not included in the final report;
- Testing methodology was not clearly documented (i.e., application methods, plot sizes, site descriptions, leaf-punch diameter, soil characteristics, and soil extraction method);
- Lack of meteorological data and irrigation supplied at each site during the time frame of the study;
- Several discrepancies between study design and label requirements, including application rates, maximum number of applications, and intervals between applications for the representative crop groupings and the analyzed crop.

For these reasons, the data from this study were not used to calculate postapplication reentry risks.

MRID No. 446880-01

In late 1998, a subsequent DFR Study - *Dissipation of Dislodgeable Foliar Disulfoton Residues from Di-Syston® 8 Treated Potatoes* - was submitted by Bayer Corporation in support of the reregistration of disulfoton. The study evaluated dislodgeable residues of disulfoton on potatoes (MRID #446880-01). This study fails to meet most of the applicable guidelines [e.g., Section 132 of Subdivision K (Exposure: Reentry Protection) of the Pesticide Assessment

Guidelines and Series 875 Group B Occupational and Residential Exposure Test Guidelines]. One application of Di-Syston® 8 was applied to potatoes growing in three major potato producing states, Michigan, North Dakota, and Washington. Three different potato varieties were grown. The application rate averaged 3.0 pounds active ingredient per acre (lb a.i./A) applied in 15 gallons water per acre (GPA), approximately 60 days prior to normal harvest, using tractor-mounted boom sprayers. No label was submitted with this study. However, the application rate is the maximum value permitted by contemporary Di-Syston® 8 labels. The label permits three applications per season, a dilution minimum of 1 GPA, and a minimum pre-harvest interval of 30 days.

At each location, three dislodgeable foliar residue (DFR) samples were collected from each of three subplots per sampling interval. Each DFR sample consisted of 48 1-inch discs punched from the leaves of the treated potato plants. Samples were collected 1 day prior to application, just after application, and 1, 2, 3, 5, 7, 9, 11, 14, and 21 days after application. The study contained the following deficiencies:

- Sample intervals were too far apart to establish a meaningful dissipation curve.
- Numerous deviations from Bayer's own QA/QC and method protocols were noted.
- The product label consulted permits 3 foliar applications per season up to a pre-harvest interval of 30 days. Only one application was made at any of the test sites, approximately 60 days prior to harvest.

Although disulfoton residues dissipated very rapidly (i.e., within hours), the first DFR samples to be collected after the immediate post-application sample were collected 24 hours later, and are (with one exception) uniformly negative for disulfoton. As a result, the data presented are inadequate to permit the plotting of a dissipation curve or calculation of an accurate residue half-life.

Estimating Postapplication Rates Using the Recent Potato DFR Study

Although the DFR study on potatoes (MRID #446880-01) does not allow EPA to calculate occupational postapplication risks to foliar applications of disulfoton due to the inadequate number of samples collected, the study does allow EPA to predict that foliar residues following a 3 lb ai per acre application to potato foliage would be dissipated to an acceptable level by 48 hours following the application. The results of the study indicate that the post-application samples collected 24 hours after application are, with one exception, uniformly negative for disulfoton. The other sample is negative at 48 hours following application. Note also that Bayer is proposing to reduce the application rate for foliar applications to 1 lb ai/acre or less on potatoes, eliminate foliar application on cotton, and cancel the uses on all other crops with foliar applications, except wheat, sorghum, and barley. These three crops have a maximum foliar application rate under Bayer's proposal of 0.75, 0.5, and 1.0 lb ai per acre respectively. If these proposed changes are

made for all disulfoton labels (i.e., not just Bayer labels), this would provide at least another 3-fold safety factor for postapplication workers adhering to a 48-hour restricted entry interval, since the study application rate was 3 lb ai per acre.

Similarly, EPA believes that a a similar restricted-entry interval would also adequately mitigate risks to postapplication workers following applications of disulfoton to soil -- either as a granular or as a spray -- for application rates up to approximately 4.0 pounds ai per acre. Based on its expertise in postapplication risk assessments, EPA believes that soil residues available for transfer from soil-directed and incorporated applications are lower than the foliar residues available for transfer after spray applications to foliage. In addition, the Agency has no evidence that disulfoton would dissipate substantially more slowly in the soil than from foliar applications. These factors lead EPA to conclude that a similar restricted-entry interval would be adequate for use patterns where the application rate is similar to the 3.0 lb ai per acre used in the potato study. All use rates for disulfoton liquid formulations are 4.0 lb ai per acre or below. Most use rates for disulfoton granular formulations are 4.3 lb ai per acre or below. The use rates for the granular labels that exceed this include:

- 102 lb ai/acre for non-bearing fruit trees,
- 28.6 lb ai/acre for flowers and groundcover, and
- 8.0 lb ai/acre for raspberries.

These high application rate soil directed granular applications are addressed in the next section.

Assumptions Used in Postapplication Exposure Calculations (Non-Cancer Risks)

The assumptions used in the calculations for occupational postapplication risks include the following items:

- Application rates used for the calculations:
  - 102 lb ai/acre for non-bearing fruit trees,
  - 28.6 lb ai/acre for flowers and groundcover, and
  - 8.0 lb ai/acre for raspberries.

- Transfer coefficients (Tc) are assumed to be 1,000 cm^2/hour for activities such as weeding and early season scouting;

- Exposure durations assumed to be 8 hours per day.

- Dermal absorption is assumed to be 36 percent, as in the intermediate-term handler assessment.

Postapplication Exposure and Non-Cancer Risk Estimates

The intermediate-term dermal risks from disulfoton has been assessed using surrogate regression data. The DFR is derived from the application rate assuming an estimated 10 percent of the rate applied is available as initial dislodgeable residues, and an estimated 25 percent dissipates per day. These assumptions have been made taking into consideration a 2-day half-life for disulfoton. The equations used for the calculations are presented below.

Dislodgeable foliar residues (DFRs) were calculated as follows:

$$DFR\left(\frac{g}{cm^2}\right) = AR\left(\frac{lb\ ai}{A}\right) \ x\ CF\left(\frac{g/cm^2}{lb\ ai/A}\right) \ x\ F\ x\ (1 - DR)^t$$

Where:

AR	=	Application rate
CF	=	Conversion factor (11.2 ug per cm^2 per lb ai per acre)
F	=	Fraction retained on foliage (20 percent)
DO	=	Daily dissipation rate (25 percent per day)
t	=	Days after treatment

Daily Absorbed Dermal Doses were calculated as follows:

$$Dose\ (mg/kg/d) = \frac{(DFR\ (\ g/cm^2)\ x\ Tc\ (cm^2/hr)\ x\ CF\left(\frac{1\ mg}{1{,}000\ \ g}\right)\ x\ Abs\ x\ ED\ (hrs/day))}{BW\ (kg)}$$

Where:

DFR	=	Dislodgeable foliar residue (g/cm^2)
Tc	=	Transfer coefficient; 1,000 cm^2/hr
CF	=	Conversion factor (i.e., 1 mg/1,000 g)
Abs	=	Dermal absorption (assume 36 percent)
ED	=	Exposure duration; 8 hours worked per day
BW	=	body weight (70 kg)

MOEs were calculated as follows:

$$MOE = \frac{NOEL\ (mg/kg/day)}{Dose\ (mg/kg/day)}$$

Where:

NOAEL	=	0.03 mg/kg/day
Dose	=	calculated absorbed dermal dose

Summary of Postapplication Risks

The acceptable MOE was assumed to be 100 for disulfoton. The resulting surrogate occupational postapplication assessments as shown in Table 9 indicate that:

- Disulfoton MOEs equal or exceed 100 for low exposure activities associated with agricultural crops (with a dermal transfer of 1,000 cm^2/hour) on the 28th day following applications at a rate of 8.0 pounds active ingredient per acre.

- Disulfoton MOEs equal or exceed 100 for low exposure activities associated with agricultural crops (with a dermal transfer of 1,000 cm^2/hour) on the 32nd day following applications at a rate of 28.6 pounds active ingredient per acre.

- Disulfoton MOEs equal or exceed 100 for low exposure activities associated with agricultural crops (with a dermal transfer of 1,000 cm^2/hour) at the 36th day following applications at a rate of 102 lb ai/acre.

These estimates should be considered a conservative maximum value based on the following observations:

- These high rates are soil directed and are often soil incoprotated (either mechanically or by watering in).

- The residue fraction that is retained on the foliage and is avaiable for transfer is likely to be subtantially less than 20 percent.

- The high application rates may rarely be used.

Additional data are required to further refine the post application exposure assessment.

Table 9. Disulfoton Intermediate-Term Surrogate Occupational Postapplication Assessment (Range Finder) for high Application Rates.

Application Rate (lb ai / acre)	DAT[a]	DFR (g/cm^2)[b]	Dermal Dose mg/kg/day	MOE
8	28	0.006	0.0002	130
28.6	32	0.006	0.0003	110
102	36	0.0007	0.0003	100

a DAT is "days after treatment."
b Initial DFR = Application rate x Conversion factor (lb ai/acre = 11.209 g/cm^2) x fraction of initial ai retained on foliage.

Residential and Other Non-Occupational Exposures and Risks

HED has determined that residential and other non-occupational handlers are likely to be exposed during disulfoton use. The anticipated use patterns and current labeling indicate several major exposure scenarios based on the types of equipment that potentially can be used to make disulfoton applications. These scenarios include: (1) loading/applying granulars with a belly grinder; (2) loading/applying granulars with a push type spreader; (3) loading/applying granulars with a spoon, shaker can, measuring scoop, or by hand; (4) application of insecticidal spikes. Registrants indicate that only dry formulations (i.e., only granulars or pellets/tablets/spikes) are permitted to be used around residences. To make sure that liquid disulfoton applications are not made at residential sites, EPA will require the following labeling statement to be placed on all disulfoton labels other than those formulated as granulars or pellets/tablets/spikes:

> "Use of this product is prohibited at residential sites, including uses on home vegetable, fruit, and ornamental gardens and houseplants."

Residential Handler Exposure Scenarios-Data and Assumptions

Residential handler exposure assessments were completed by HED using a baseline exposure scenario. PHED values used to estimate daily unit exposure values were taken from the *Standard Operating Procedures (SOPs) for Residential Exposure Assessments* document dated December 1997.[5] Table 10 summarizes the caveats and parameters specific to the surrogate data used for each scenario and corresponding exposure/risk assessment. The following assumptions and factors were used in order to complete this exposure assessment:

- Calculations are completed at the maximum application rates for specific crops recommended by the available disulfoton labels to bracket risk levels associated with the various use patterns. No use data were provided by the registrant concerning the actual application rates that are commonly used for disulfoton.

- Generally, the use of PPE and engineering controls are not considered acceptable options for products sold for use by homeowners because they are not available, and/or inappropriate for the exposure scenario (e.g., acceptability rationale is based on a lack of enforcement, available PPE, and training).

- PHED values represent a handler wearing typical residential clothing attire of short sleeve shirt, short pants and no gloves.

- The number of rose bushes assumed for treatment per day by a homeowner is 50 rose bushes.

- The number of pots treated per day by a homeowner is 20 six inch pots.

- The number of ornamental shrubs or trees treated per day by a homeowner is assumed to be 25.

- The area treated with granulars for flower or vegetable gardens by a homeowner is assumed to be 1,000 ft^2. For pre-planting treatment of flower and vegetable gardens with a belly grinder, the treatment area is assumed to be 10,000 ft^2.

Residential Handler Exposure and Non-Cancer Risk Estimates

The calculations of daily dermal and inhalation exposure, short-term doses, and total short-term MOEs were made using the same formulas as presented earlier for occupational handlers.

Table 11 presents residential dermal and inhalation exposures associated with the handling of disulfoton. Table 12 presents the short-term dermal and inhalation risks as well as total MOEs resulting from those exposures.

Table 10. Residential Exposure Scenario Descriptions for the Use of Disulfoton

Exposure Scenario (Number)	Data Source	Standard Assumptions[a]	Comments[b]
Mixer/Loader/Applicator Descriptors			
Loading/Applying Granulars Using a Belly Grinder (1)	SOPs for Residential Exposure Assessments (12/97)	10,000 ft^2 for pre-planting of flower/vegetable gardens	**Baseline:** Dermal and hands data = ABC grades, inhalation = AB grade. Dermal 20-45 replicates; hands = 23 replicates; and inhalation = 40 replicates. Medium confidence for hands and dermal, and high confidence for inhalation. **PPE and Engineering Controls**: Not required for assessment.
Loading/Applying Using a Push-type Granular Spreader (2)	SOPs for Residential Exposure Assessments (12/97)	10,000 ft^2 for vegetable gardens, 1,000 ft^2 for flower gardens, and 25 shrubs	**Baseline:** Hands = C grade, and inhalation data = B grade. Hand = 15 replicates; dermal = 0-15 replicates; and inhalation = 15 replicates. Low confidence in hands and dermal data, and high confidence in inhalation data.. A 50% protection factor was used to "backcalculate" a short sleeved shirt value from long sleeve shirt data. **PPE and Engineering Controls**: Not required for assessment.
Loading/Applying Granulars by Spoon, Shaker Can, Measuring Scoop, or by Hand (3) (PHED values for Granular Bait Dispersed by Hand used as a surrogate for these application methods)	SOPs for Residential Exposure Assessments (12/97)	50 rose bushes, 1,000 ft^2 for vegetable gardens, 1,000 ft^2 for flower gardens, and 25 shrubs	**Baseline:** Dermal, hands and inhalation data = ABC grade. Hands, dermal and inhalation = 16 replicates. Medium confidence in all data. A 90% PF was applied to gloved hands data to backcalculate "no glove" hand exposure. **PPE and Engineering Controls**: Not required for assessment
Application of Insecticidal Spikes (4)	NA	NA	**No Data**

[a] Standard Assumptions based on HED estimates.

[b] "Best Available" grades are defined by HED SOP for meeting Subdivision U Guidelines. Best available grades are assigned as follows: matrices with grades A and B data and a minimum of 15 replicates; if not available, then grades A, B and C data and a minimum of 15 replicates; if not available, then all data regardless of the quality and number of replicates. Data confidence are assigned as follows:

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

NA = Not Applicable

Table 11: Residential Handler Dermal and Inhalation Exposures to Disulfoton at Baseline

Exposure Scenario (Scenario #)	Baseline Dermal Unit Exposure (mg/lb ai)[a]	Baseline Inhalation Unit Exposure (µg/lb ai)[b]	Range of Application Rates[c]	Crop Type or Target[d]	Amount Handled Per Day[e]	Daily Dermal Exposure (mg/day)[f]	Daily Inhalation Exposure (mg/day)[g]
Mixer/Loader/Applicator Exposure							
Loading/Applying Granulars with a Belly Grinder[h] (1)	110	62	0.2 lb ai/1000 ft^2	Flower/Vegetable Gardens (pre-planting)	10,000 $ft.^2$	220	0.12
			0.1 lb ai/1000 ft^2			110	0.062
Loading/Applying Granulars with a Push Type Spreader (2)	3	6.3	0.00188 lb ai/bush	Roses	50 bushes	0.28	0.00059
			0.1125 lb ai/1,000 ft^2[j]	Vegetable Gardens	10,000 $ft.^2$	3.4	0.0071
			0.0313 lb ai/1,000 ft^2[j]			0.94	0.0020
			0.3 lb ai/1,000 ft^2	Flower Gardens	1,000 $ft.^2$	0.9	0.0019
			0.1 lb ai/1,000 ft^2			0.3	0.00063
			0.005 lb ai/1,000 ft^2			0.015	0.000032
			1.32 lb ai/4 ft. shrub	Ornamental Shrubs/ Small Trees	25 shrubs	99	0.21
			0.01 lb ai/4 ft. shrub			0.75	0.0016
			0.00032 lb ai/4 ft. shrub			0.024	0.000050
Loading/Applying Granulars with a Spoon, Shaker Can, Measuring Scoop, or by Hand[i] (3)	430	470	0.00188 lb ai/bush	Roses	50 bushes	40	0.044
			0.1125 lb ai/1,000 ft^2[j]	Vegetable Gardens	10,000 $ft.^2$	480	0.53
			0.0313lb ai/1,000 ft^2[j]			130	0.15
			0.3 lb ai/1,000 ft^2	Flower Gardens	1,000 $ft.^2$	130	0.14
			0.1 lb ai/1,000 ft^2			43	0.047
			0.005 lb ai/1,000 ft^2			2.2	0.0024
			1.32 lb ai/4 ft. shrub	Ornamental Shrubs/ Small Trees	25 shrubs	14,000	16
			0.01 lb ai/4 ft. shrub			110	0.12
			0.00032 lb ai/4 ft. shrub			3.4	0.0038
			0.00011 lb ai/6" pot	Potted Plants	20 pots	0.95	0.001
Application of Insecticidal Spikes (4)	No Data	No Data	No Data	No Data	No Data	No Data	No Data

Table 12: Residential Handler Dermal and Inhalation Exposures to Disulfoton at Baseline (Continued)

Footnotes:

[a] Baseline Dermal Unit Exposure represents short pants, short sleeved shirt, no gloves, and open mixing/loading.
[b] Baseline Inhalation Exposure represents no respirator.
[c] Application Rates are maximum rate values found on disulfoton labels (EPA Reg. No. 769-908, 572, 346, 33955-489, 4-253, 869-223, 3125-83).
[d] Crop Type or Target provides a general description of the intended uses of disulfoton. Separate categories are presented because of the distinct differences in application rates and amount handled.
[e] Daily Amount Handled values are from default estimates of square footage, or number of bushes shrubs or pots that could be treated in a single day for each exposure scenario.
[f] Daily Dermal Exposure (mg/day) = Unit Exposure (mg/lb ai) * Appl. rate * Amount Handled per day.
[g] Daily Inhalation Exposure (mg/day) = Unit Exposure (µg/lb ai) * (1mg/1000 µg) Conversion * Application Rate (lb ai/A) * Acres treated (acres/day).
[h] Residential application of disulfoton using a belly grinder are applicable for pre-plant treatment applications only.
[I] Unit exposure data for application of granules by hand were used as surrogate values for these scenarios.
[j] Application rates for small vegetable gardens are based on 24-inch row spacing (EPA Reg. No. 769-908).

Table 12: Residential Handler Short-term Risks from Disulfoton at Baseline

Exposure Scenario (Scenario #)	Crop Type or Target[a]	Amount Handled Per Day[b]	Application Rate	Baseline Dermal		Baseline Inhalation		Baseline Total
				Daily Dose (mg/kg/day)[c]	Short-term MOE[d]	Daily Dose (mg/kg/day)[e]	Short-term MOE[f]	Short-term MOE [g]
Mixer/Loader/Applicator Risks								
Loading/Applying Granulars with a Belly Grinder (1)	Flower/Veg. Gardens (pre-planting)	10,000 ft.^{2}	0.2 lb ai/1000 ft^2	3.1	0.1	0.0017	26	0.1
			0.1 lb ai/1000 ft^2	1.6	0.3	0.00089	51	0.3
Loading/Applying Granulars with a Push Type Spreader (2)	Roses	50 bushes	0.00188 lb ai/bush	0.0040	99	8.4E-6	5,300	99
	Vegetable Gardens	10,000 ft.^{2}	0.1125 lb ai/1,000 ft^2 [h]	0.048	8.3	0.00010	440	8.2
			0.0313 lb ai/1,000 ft^2 [h]	0.013	30	0.000029	1,600	30
	Flower Gardens	1,000 ft.^{2}	0.3 lb ai/1,000 ft^2	0.013	31	0.000027	1,700	31
			0.1 lb ai/1,000 ft^2	0.0043	93	0.0000090	5,000	93
			0.005 lb ai/1,000 ft^2	0.00021	1,900	4.6E-7	98,000	1,900
	Ornamental Shrubs/ Small Trees	25 shrubs	1.32 lb ai/4 ft. shrub	1.4	0.3	0.0030	15	0.3
			0.01 lb ai/4 ft. shrub	0.011	37	0.000023	2,000	37
			0.00032 lb ai/4 ft. shrub	0.00034	1,200	7.1E-7	63,000	1,200
Loading/Applying Granulars with a Spoon, Shaker Can, Measuring Scoop, or by Hand (3)	Roses	50 bushes	0.00188 lb ai/bush	0.58	0.7	0.00063	72	0.7
	Vegetable Gardens	10,000 ft.^{2}	0.1125 lb ai/1,000 ft^2 [h]	6.9	0.06	0.0076	5.9	0.06
			0.0313lb ai/1,000 ft^2 [h]	1.9	0.2	0.0020	21	0.2
	Flower Gardens	1,000 ft.^{2}	0.3 lb ai/1,000 ft^2	1.8	0.2	0.0020	23	0.2
			0.1 lb ai/1,000 ft^2	0.61	0.7	0.00067	67	0.6
			0.005 lb ai/1,000 ft^2	0.03	13	0.000034	1,300	13
	Ornamental Shrubs/ Small Trees	25 shrubs	1.32 lb ai/4 ft. shrub	200	0.002	0.23	0.2	0.002
			0.01 lb ai/4 ft. shrub	1.5	0.3	0.0017	26	0.3
			0.00032 lb ai/4 ft. shrub	0.049	8.1	0.000054	830	8.1
	Potted Plants	20 pots	0.00011 lb ai/6" pot	0.014	30	0.000014	3,200	29

Table 13: Residential Handler Short-term Risks from Disulfoton at Baseline (Continued)

Exposure Scenario (Scenario #)	Crop Type or Target[a]	Amount Handled Per Day[b]	Application Rate	Baseline Dermal		Baseline Inhalation		Baseline Total
				Daily Dose (mg/kg/day)[c]	Short-term MOE[d]	Daily Dose (mg/kg/day)[e]	Short-term MOE[f]	Short-term MOE [g]
Application of Insecticidal Spikes (4)	Roses/Trees	No Data	No Data	No Data	No Data	No Data	No Data	No Data

Footnotes:

[a] Crop Type or Target provides a general description of the intended use of various products containing disulfoton. Separate categories are presented because of the distinct differences in application rates and acres treated.
[b] Amount Handled Per Day values are from default estimates of square footage or number of pots treated a single day for each exposure scenario of concern.
[c] Daily Dermal Dose (mg/kg/day) = Daily Dermal Exposure (mg/day)/ Body weight (70 kg).
[d] Short-term Dermal MOE = NOAEL (0.4 mg/kg/day)/ Daily Dermal Dose (mg/kg/day).
[e] Daily Inhalation Dose (mg/kg/day) = Daily Inhalation Exposure (mg/day)/ Body weight (70 kg).
[f] Short-term Inhalation MOE = NOAEL (0.045 mg/kg/day)/ Daily Inhalation Dose (mg/kg/day).
[g] Total Short-term MOE = 1/ [(1/ Short-term Dermal MOE) + (1/ Short-term Inhalation MOE)].
[h] Application rates for small vegetable gardens are based on 24-inch row spacing (EPA Reg No. 769-908).

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

Short-term dermal and inhalation risks for homeowner-handlers were assessed as well as the total risks associated with the handling of disulfoton

Handler Scenarios with Risk Concerns

The calculations of short-term dermal and inhalation risks indicate that **total short-term MOEs** are **greater than 100** at baseline for the following scenarios:

(2) loading/applying with a push type granular spreader to flower gardens using an application rate of 0.005 lb ai/1000 ft^2

(2) loading/applying with a push type granular spreader to ornamental shrubs and small trees using an application rate of 0.00032 lb ai/four foot shrub

Data Gaps

Data gaps exist for the following scenario:

(4) applying insecticidal spikes to rose bushes, or ornamental shrubs and trees

Data Quality and Confidence in Assessment

Several issues must be considered when interpreting the non-occupational exposure risks

- PHED hands and dermal values are ranked in the low confidence category for application with a push type granular spreader.
- Factors used to calculate daily exposures to handlers (e.g. square footage treated per day, number of pots treated and number of shrubs or trees treated in a day) are based on the best professional judgement due to a lack of pertinent data.

Non-occupational Postapplication Exposures and Risks

Residential Postapplication Exposures and Assumptions

HED has determined that there are potential postapplication exposures to residents based on the following scenarios:

- transplanting, hoeing, and weeding treated ornamental shrubs and trees (including rose bushes),

- weeding, transplanting, and hoeing treated ornamental flowers;
- non-harvest activities such as weeding and hoeing of home vegetable crops; and
- incidental soil ingestion.

Data Source Descriptions for Scenarios Considered

A surrogate postapplication exposure assessment was conducted to determine potential risks for incidental soil ingestion. EPA has no data upon which to assess postapplication contact with treated soil through activities such as weeding, hoeing, and transplanting home ornamentals and vegetable crops or houseplants.

Assumptions Used in Post application Exposure Calculations

The assumptions used in the calculations for residential postapplication risks include the following items:

- NOAEL of 0.03 mg/kg/day were used in the assessment.
- On the day of application, it was assumed that 20 percent of the application rate is located with the soil's uppermost 1 cm. The *Residential SOP's* specify a 100 percent assumption; however after disulfoton treatment followed by soil incorporation, the insecticide should be uniformly dispersed into the top 2 inches of soil.
- The assumed soil ingestion rate for children (ages 1-6 years) was assumed to be 100 mg/day.
- Application rate used in the residential assessment are described above.
- Toddlers (3 years old) used to represent the 1 to 6 year old age group, were assumed to weigh 15 kg.
- Postapplication was assessed on the same day the pesticide is applied because it was assumed that the homeowner could be exposed to soil immediately after application. Therefore, postapplication exposures were based on day 0.

Postapplication Exposure and Non-Cancer Risk Estimates

Table 13 presents the postapplication risks from the incidental soil ingestion by toddlers of soil treated with disulfoton. The following equations were used:

Incidental Soil Ingestion:

$$ADD = (SR_t * IgR * CF1) / BW$$

where:

ADD	=	average daily dose (mg/kg/day)
SR_t	=	soil residue on day "t" (g/g), assuming average day of reentry "t" is day 0
IgR	=	ingestion rate of soil (mg/day), assumed to be 100 mg/day
CF1	=	weight unit conversion factor to convert the g of residues on the soil to grams to provide units of mg/day (1E-6 g/ g)
BW	=	body weight (kg), assumed 15 kg for toddlers

and

$$SR_t = AR * F * (1-D)^t * CF2 * CF3 * CF4$$

where:

AR	=	application rate (lb ai/acre)
F	=	fraction of ai available in uppermost cm of soil (fraction/cm), assumed to be 20 percent based on soil incorporation into top 2 inches of soil after application
D	=	fraction of residue that dissipates daily (unitless)
t	=	postapplication day on which exposure is being assessed
CF2	=	weight unit conversion factor to convert the lbs ai in the application rate to g for the soil residue value (4.54E8 g/lb)
CF3	=	area unit conversion factor to convert the surface area units (ft^2) in the application rate to cm^2 for the SR value (2.47E-8 acre/cm^2 if the application rate is per acre)
CF4	=	volume to weight unit conversion factor to convert the volume units (cm^3) to weight units for the SR value (0.67 cm^3/g soil)[7]
t	=	postapplication day on which exposure is being assessed, assumed to be day 0

Summary of Residential Postapplication Risks

The target residential MOE is 100 for disulfoton. The resulting surrogate residential postapplication assessment for toddlers indicates that the disulfoton MOEs for incidental soil ingestion were greater than 100 for vegetable garden soil (application rate 4.9 lb ai/acre).

Table 13. Residential Post-application Risks from Incidental Soil Ingestion of Disulfoton

Scenario	Receptor	Application Rate Per Treatment (AR) (lbs ai/A)[a]	SRt (ug/g)[b]	IgR (mg/day)	BW (kg)	ADD (mg/kg/day) [c]	MOE [d]
Incidental soil ingestion (Flower beds)	Toddler	13	20	100	15	0.00013	230
Incidental soil ingestion (Vegetable garden beds)	Toddler	4.9	7.4	100	15	0.000049	610

a Application rate for flower and vegetable gardens
b Soil residue (ug/g) = [AR (lbs ai/A) * 4.54E+8 ug/lb * 2.47E-8 A/cm^2 * 0.67 cm^3/g soil * 0.2/cm].
c Average daily dose (ADD) (mg/kg/day) = [SRt (ug/g) * IgR (mg/day) * g/1,000,000 ug] / [BW (kg)].
d MOE = NOAEL (0.03 mg/kg/day) / ADD.

References

1) U.S. EPA 1998. Disulfoton, PC0032501: Report of Hazard Identification Assessment Review Committee dated April 9, 1998.

2) U.S. EPA 1997. Iprodione LUIS Table for Exposure Assessors (PRD report dated 11/06/96 and report run date 06/12/97.

3) Disulfoton Labels.

4) Pesticide Handler Exposure Database Version 1.1 Surrogate Exposure Table. May 1997.

5) September 27, 1991 Memo from Peg Perreault, OREB Branch to Lois Rossi, Special Review and Reregistration Division. Subject: In Depth Review of Postapplication/Reentry Data Submitted to Support the Reregistration of Azinphos-Methyl (HED Project #s 0-467, 9-0972, 8-1164, 9-0811, and 9-0812).

6) U.S. EPA 1997. Draft Standard Operating Procedures (SOPs) for Residential Exposure Assessments. December 1997.

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OREB Files