MAR - 6 1996

MEMORANDUM

SUBJECT: AGRICULTURAL EXPOSURE ASSESSMENT AND RECOMMENDATIONS FOR THE REREGISTRATION ELIGIBILITY DECISION DOCUMENT FOR CHLORPYRIFOS.

TO: Michael S. Metzger, Chief
Risk Characterization and Analysis Branch
Health Effects Division (7509C)

FROM: Bruce Kitchens, Chemist

THRU: Mark I. Dow, Ph.D, Section Head
Special Review and Registration Section II

Larry C. Dorsey, Chief
Occupational and Residential Exposure Branch
Health Effects Division (7509C)

Please find the OREB review of chlorpyrifos.

DP Barcode:	D203766
Pesticide Chemical Codes:	059101
EPA Reg. Nos.:	62719-163, 39, 221, 23, 245, 34, 255
EPA MRID Nos.:	429745-01, 431381-02, and 430279-01
LUIS Report Date:	10/02/95
PHED:	Yes: Version 1.1

AGRICULTURAL EXPOSURE CHAPTER

This document is for use in EPA's development of the chlorpyrifos Reregistration Eligibility Decision Document (RED). OREB presents the results of its review of the potential human agricultural exposure to chlorpyrifos. Included is a discussion of the adequacy of the agricultural exposure data that have been submitted in support of the reregistration of chlorpyrifos.

(RED SECTION III - TOXICITY, EXPOSURE, AND RISK)

(EXPOSURE)

Agricultural

An agricultural 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.

Use Summary

Use Patterns

Chlorpyrifos [O,O-diethyl O-(3,5,6-trichloro-2-pyridyl) phosphorothioate], is an organophosphate insecticide formulated as a wettable powder (containing 50 percent a.i.), dust (containing 0.125 to 1.0 percent a.i.), granular (containing 0.14 to 15 percent a.i.), bait (containing 0.03 to 1.0 percent a.i.), liquid flowable (containing 0.5 to 30 percent a.i.), impregnated material (containing 0.9 to 10 percent a.i.), pellets/tablets (containing 0.5 to 1.0 percent a.i.), pressurized liquids (containing 0.25 to 3.8 percent a.i.), microencapsulates (containing 0.15 to 20 percent a.i.), dry flowables (containing 50 percent a.i.), soluble concentrate/liquids (containing 0.5 to 62.5 percent a.i.), and liquid ready-to-use (containing 0.22 to 1.0 percent a.i.).[1,2]

Chlorpyrifos is currently registered for the control of various insects including fleas, ticks, termites, cockroaches, cutworms, grasshoppers, aphids, etc. on/in grain crops, nut crops, bananas, cole crops, citrus, pome and strawberry fruits, forage, field and vegetable crops, lawns and ornamental plants, poultry, beef cattle, sheep, livestock premise treatment, and direct application to stagnant water, etc.[1,2] It can also be used in greenhouses. Only the agricultural and greenhouse uses of chlorpyrifos are addressed in this section.

Chlorpyrifos is applied by aerial/groundboom equipment, hand held sprayers, chemigation (sprinkler irrigation) and dusts.[1,2] Applications are made as often as every day. Only the agricultural and greenhouse applications of chlorpyrifos are addressed in this section.

Agricultural Occupational-use products

At this time some products containing chlorpyrifos are intended primarily for homeowner use, and some are intended primarily for occupational use. Only the occupational agricultural and greenhouse uses are addressed in this section.

Summary of Toxicity Concerns Impacting Agricultural Exposures

Acute Toxicity Categories

Guideline studies for acute toxicity indicate that the technical grade chlorpyrifos is classified as category II for acute oral toxicity, category II for acute dermal toxicity, category II for acute inhalation toxicity, category III for skin irritation potential, and category III for eye irritation potential.[3] It is not classified as a skin sensitizer. Chlorpyrifos has a vapor pressure of 1.87×10^{-5}mm Hg at 20° C.

Other Endpoints of Concern

The *Toxicology Endpoint Selection Document*, dated August 15, 1994, indicates that there are toxicological end-points of concern for chlorpyrifos. Both the short term and intermediate term end-points (i.e., plasma cholinesterase inhibition) for chlorpyrifos are based on a NOEL of 0.03 mg/kg/day from a daily oral human volunteer study.[3] One percent dermal absorption is used for the risk calculations.[4] Additionally, chlorpyrifos is classified as a Group E carcinogen.[3]

Poisoning Incident Data

Note: Incident data analysis is in a separate report.

Handler Exposures & Assumptions

EPA has determined that there is a potential exposure to mixers, loaders, applicators, or other handlers during usual use-patterns associated with chlorpyrifos. Based on the use patterns and potential exposures described above, 17 major agricultural and/or greenhouse exposure scenarios are identified for chlorpyrifos.

Uses that have solely agricultural exposure scenarios include: (1) mixing/loading the liquid formulation to support aerial, airblast, and groundboom applications, (2) mixing/loading the wettable powder formulation to support aerial, airblast, and groundboom applications, (3) loading the dry (granular) formulation to support aerial and ground applications, (4) mixing/loading the dry flowable formulation to support aerial, airblast, and groundboom applications, (5) applying the liquid/dry flowable/ wettable powder/granular formulations with aerial equipment, (6) applying the liquid/dry flowable/wettable powder formulation with groundboom equipment, (7) applying the liquid/dry flowable/wettable powder formulation with airblast equipment, (8) applying the granular formulation with row-planter equipment, (9) applying the granular formulation with broad-cast spreader equipment, (10) applying in commercial seed-treatment equipment, (11) applying as a preplant-dip treatment, (12) flagging for aerial spray applications, (13) flagging for aerial granular applications, (14) mixing, loading, and applying a spray application to tree-trunks using tractor/truck-mounted equipment and a hand-held nozzle (orchards), (15) mixing/loading and applying with a back-pack sprayer (greenhouse uses), (16) mixing/loading and applying with low-pressure hand-wand sprayer (greenhouse uses), and (17) mixing/loading and applying with a high pressure handwand (greenhouse uses).

Mixer/loader/applicator (M/L/A) exposure data for chlorpyrifos were required during the data call-in (DCI) on September 18, 1991, since one or more toxicological criteria had been triggered. Requirements for applicator exposure studies are addressed by Subdivision U of the Pesticide Assessment Guidelines. The following three studies were submitted by the registrant and are summarized below.

- MRID No. - 430279-01. Contardi, J.S. et al. 1993. Evaluation of Chlorpyrifos exposures during mixing/loading and application of Empire*20 insecticide to ornamental plants in greenhouses. Study ID No. HEH 2.1-1-182(130).

  Passive dosimetry (dermal and inhalation) and biological monitoring (urine analysis) were conducted for 16 combined mixer/loader/applicator replicates. Of the 16 replicates monitored, 1 replicate was a low pressure handwand, 2 replicates were for backpack sprayers, and 13 replicates were for high pressure handwands. The applications were made at various heights (i.e., floor, bench, overhead) to ornamental plants in a greenhouse. To summarize, an insufficient number of replicates were monitored for low pressure handwand and the backpack sprayer application techniques to meet the acceptability criteria outlined in Subdivision U of the Pesticide Assessment Guidelines. The quality control/quality assurance aspect of the passive dosimetry was adequate for the dermal whole-body dosimeters and inhalation canisters; however, the laboratory recovery results for the hand rinses were highly variable (i.e., 118.0 +/- 23.9 percent). The quality control/quality assurance aspect of the biological monitoring is sufficient, except that field spikes were prepared for only 10 of the 16 replicates (minimum of 2 field spikes per day of sampling).

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- MRID No. - 429745-01. Shurdut, B.A. et al. 1993. Lorsban 4E and 50W insecticides: assessment of Chlorpyrifos exposures to applicators, mixer/loaders and re-entry personnel during and following application to low crops.

  Passive dosimetry (dermal and inhalation) and biological monitoring (urine analysis) samples were collected for 9 replicates of open cab groundboom tractors, 6 replicates of open mixing of a 4EC formulation, and 3 replicates of open pour of a 50WP formulation. The applications were made at preplant on cauliflower and tomato plants. To summarize, an insufficient number of replicates were monitored for each formulation for mixing/loading and for groundboom application to meet the acceptability criteria outlined in Subdivision U of the Pesticide Assessment Guidelines. The quality control/quality assurance aspect of the passive dosimetry was adequate for the dermal whole-body dosimeters, hand rinses, and inhalation canisters. The quality control/quality assurance aspect of the biological monitoring was sufficient.

- MRID No. - 431381-02. Honeycutt, R.C. & Day, E.W. Jr. 1994. Evaluation of the potential exposure of workers to Chlorpyrifos during mixing and loading, spray application, and clean-up procedures during the treatment of citrus groves with Lorsban 4E insecticide. Study ID No. 91-101HE.

  Passive dosimetry (dermal and inhalation) and biological monitoring samples (urine analysis) were collected for 15 open pour liquid mixer/loader replicates and 15 open cab airblast applicator replicates. The applications were made to citrus groves (i.e., lemons and oranges) at the maximum label rate of 6 lb ai/acre. To summarize, the study meets the acceptability criteria outlined in Subdivision U of the Pesticide Assessment Guidelines. The quality control/quality assurance aspect of the passive dosimetry was adequate for the dermal whole-body dosimeters and inhalation canisters; however, the field recovery results for the hand rinses are questionable (i.e., 131 percent). The quality control/quality assurance aspect of the biological monitoring was sufficient.

Table 1 presents the exposure scenarios and exposure calculations (i.e., passive dosimetry) using the above chemical-specific exposure studies and PHED. PHED has been used to supplement the chemical-specific data and to assess the exposure to use scenarios which were not monitored by the registrant. The results of the biological monitoring portion of the above studies are presented below in the risk section.

For passive dosimetry, daily dermal exposure is calculated using the following formula:

$$\text{Daily Dermal Exposure}\left(\frac{mg\ AI}{Day}\right) \quad \text{Dermal Unit Exposure}\left(\frac{mg\ AI}{lb\ AI}\right) \quad \text{Max. Appl. Rate}\left(\frac{lb\ AI}{Acre}\right) \quad \text{Max. Area Treated}\left(\frac{Acres}{Day}\right)$$

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Daily inhalation exposure is calculated using the following formula:

$$\text{Daily Inhal. Exposure}\left(\frac{mg\ AI}{Day}\right) \quad \text{Inhal. Unit Exposure}\left(\frac{mg\ AI}{lb\ AI}\right) \quad \text{Max. Appl. Rate}\left(\frac{lb\ AI}{Acre}\right) \quad \text{Max. Area Treated}\left(\frac{Acres}{Day}\right)$$

These calculations of daily exposure to chlorpyrifos by handlers are used to assess the risk to those handlers.

Post-Application Exposures & Assumptions

EPA has determined that there is potential exposure to persons entering treated sites after application is complete. There is potential exposure to agricultural workers following applications on farms, forests, nurseries, and greenhouses.

Post-application exposure data were required during the chlorpyrifos DCI of the reregistration process, since, at that time, one or more toxicological criteria had been triggered for chlorpyrifos.

The following post-application study was submitted by the registrant:

- MRID No. - 429745-01. Shurdut, B.A. et al. 1993. Lorsban 4E and 50W insecticides: assessment of chlorpyrifos exposures to applicators, mixer/loaders and re-entry personnel during and following application to low crops.

  Passive dosimetry (dermal and inhalation) and biological monitoring samples (urine analysis) were collected for 10 replicates of scout reentry into cauliflower and tomato sites. The dermal reentry was monitored approximately 24 hours after chlorpyrifos treatment. Foliar dislodgeable residues (FDR) were collected on 0, 1, 2, 3, 5, 7, 14, 21, and 30 days after treatment (DAT). The post-application portion of this study used the Lorsban 50W formulation. The Lorsban 50W was applied by groundboom to cauliflower in Arizona and tomatoes in Florida at 1 lb ai/acre. To summarize, this study meets the acceptability criteria outlined in Subdivision K of the Pesticide Assessment Guidelines. Results from this study can be used to support scout re-entry exposure only. The quality control/quality assurance aspect of the study was adequate.

The submitted study (MRID No. 429745-01) only monitored scouts reentering treated cauliflower and tomato sites. The average daily exposure for the scouts are presented below. These results were calculated using the actual FDR data and calculated transfer coefficients (Tc) from the registrant's study. Because of the absence of additional FDR data for other

crops, the cauliflower and tomato sites were used in conjuction with surrogate harvesting Tc to estimate average daily exposure to low, medium, and high crops.

Daily Exposure of Scouts Reentering Sites Treated with Chlorpyrifos

Crop	DAT	FDR ($\mu g/cm^2$)[a]	Daily Exposure (mg/day)[b]
Scouts (Actual Data)			
Cauliflower	0	0.7240	4.3
Tomatoes	0	0.2399	1.3

DAT = Days after treatment (after sprays have dried)

[a] FDR data based on best fit for cauliflower and tomato scouts.

[b] $\text{Daily Exposure (mg/day)} = \text{FDR (µg/cm2)} \left(\frac{1\text{ mg}}{1{,}000\text{ µg conversion}}\right) T_c \; 8\text{ hours/day}$

where:

Scout T_c (cauliflower) = 738 cm^2/hr
Scout T_c (tomatoes) = 677 cm^2/hr

Daily Exposure of Harvesters Reentering Sites Treated with Chlorpyrifos

Crop	DAT	FDR ($\mu g/cm^2$)[a]	Daily Exposure (mg/day)[b]
Harvesters (Surrogate Data)			
Low Crops	5	0.2262	18.1
Medium Crops	22	0.2525	20.23
Grapes	35	0.6338	91.28
High Crops	34	0.2476	19.81

DAT = Days after treatment (after sprays have dried)

[a] Harvesting FDR data for low crops are based on best fit for cauliflower. Harvesting FDR data for medium crops, grapes, and high crops are based on the average best fit FDR data for cauliflower and tomatoes normalized by the application rate for the selected medium crops (tobacco 3 lb ai/acre), grapes (16.3 lb ai/acre), and high crops (citrus 6 lb ai/acre).

[b] $\text{Daily Exposure (mg/day)} = \text{FDR (µg/cm2)} \left(\frac{1\text{ mg}}{1{,}000\text{ µg conversion}}\right) T_c \; 8\text{ hours/day}$

where:

Harvester T_c (low crops) = 10,000 cm^2/hr
Harvester T_c (medium crops) = 10,000 cm^2/hr

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Harvester T_c (grapes) = 18,000 cm^2/hr
Harvester T_c (high crops) = 10,000 cm^2/hr

These calculations of daily exposure to chlorpyrifos by persons entering the treated area after application are used to assess the risk to those persons.

(RISK)

Agricultural

Using the daily dermal exposure values calculated in the exposure section (i.e., passive dosimetry), EPA calculated the potential risk to persons from handler exposures and post-application exposures to chlorpyrifos.

Daily Absorbed Total Dose (mg/kg/day) is calculated as:

$$\frac{\text{Daily Dermal Exposure (mg/day)} \quad 0.01 \text{ (dermal absorption)}}{\text{Body Weight (kg)}} ; \frac{\textit{Daily Inhalation Exposure (mg/day)}}{\textit{Body Weight (kg)}}$$

Margin of Exposure (MOE) is calculated by dividing the NOEL by the daily absorbed total dose.

$$\text{Short- or Intermediate- Length Exposure MOE} = \frac{\text{NOEL}}{\text{Daily Absorbed Total Dose}}$$

Risk From Handler Exposures

Margins of exposure (MOEs) for occupational exposure were calculated for handlers for short-term (one to seven days) and intermediate-term (one week to several months) exposure. Table 2 presents the dose and MOE calculations plus the risk mitigation measures using the passive dosimetry results for the agricultural and greenhouse uses of chlorpyrifos. Table 3 presents the passive dosimetry scenario descriptions of data confidence for the agricultural and greenhouse uses of chlorpyrifos. Tables 4 and 5 present the biological monitoring results and risk mitigation measures, respectively. Biological monitoring is used exclusively to assess the risks to workers using groundboom and airblast application equipment. The biological monitoring results are also presented for low pressure handwand, backpack, and high pressure handwand uses in greenhouses as monitored in the submitted studies.

EPA calculated the baseline total MOE for each of the exposure scenarios using the following baseline PPE assumptions:

- all occupational handlers are wearing footwear (socks plus shoes or boots),

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- occupational mixers and loaders are wearing chemical-resistant gloves plus long-sleeved shirts and long pants,

- occupational applicators who use airblast or tractor-driven application equipment and handlers flagging for aerial applications are wearing long-sleeved shirts and long pants, but no gloves, and

- occupational handlers (mixers, loaders, and applicators) who use hand-held application equipment are wearing long-sleeve shirts and long pants, but no gloves.

If the baseline dermal MOE calculated using this baseline PPE was 10 or greater (since the NOEL is based on data from human studies) for an exposure scenario, then no further calculations were made. If the baseline dermal MOE was less than 10 for any exposure scenario, an additional dermal MOE was calculated based on increasing the level of PPE over the baseline PPE. OREB calculated the additional-PPE dermal MOE for each occupational exposure scenario with a baseline dermal MOE of less than ten, using the following additional PPE assumptions:

- all occupational handlers are wearing footwear (socks plus shoes or boots),

- occupational mixers and loaders are wearing chemical-resistant gloves plus coveralls worn over long-sleeved shirts and long pants,

- occupational applicators who use airblast or tractor-driven application equipment and handlers flagging for aerial applications are wearing chemical-resistant gloves (except flaggers -- no gloves) plus coveralls worn over long-sleeved shirts and long pants, and

- occupational handlers who use low pressure handwands are wearing chemical-resistant gloves plus long-sleeve shirts and long pants. When the addition of chemical-resistant gloves does not increase the dermal MOE to ten or greater, an additional maximum-PPE total MOE is calculated with the assumption that these handlers are wearing chemical-resistant gloves plus coveralls worn over long-sleeve shirts and long pants. Also, if necessary, a dust/mist respirator is added to mitigate the risks.

If the additional-PPE dermal MOE calculated using this additional-PPE was ten or greater (the NOEL is based on data from human studies) for an exposure scenario, then no further calculations were made. If the additional-PPE dermal MOE remained less than ten for any occupational exposure scenario, an addition dermal MOE was calculated based on mandatory use of engineering controls where feasible. Engineering controls are not considered feasible for occupational handlers (mixers, loaders, and applicators) who use hand-held application equipment. OREB calculated the engineering-control dermal MOE for

each occupational exposure scenario with an additional-PPE dermal MOE of less than ten, using the following engineering control assumptions:

- all occupational handlers are wearing footwear (socks plus shoes or boots),
- occupational mixers and loaders handling liquid formulations using a closed system are wearing chemical-resistant gloves plus long-sleeved shirts and long pants,
- occupational mixers and loaders handling dry formulations (wettable powders, dry flowables, granules) using a closed system (water-soluble packages or "lock-and-load" systems) are wearing long-sleeved shirts and long pants, but no gloves, and
- occupational applicators who use aerial, airblast, or tractor-driven application equipment and handlers flagging for aerial applications are located in enclosed cabs or cockpits and are wearing long-sleeved shirts and long pants, and no gloves.

The MOEs were ten or greater for the following exposure scenarios outlined below:

OCCUPATIONAL MIXERS/LOADERS

- mixing liquid formulations for aerial applications (Engineering Control: Closed mixing/loading system; PPE: chemical-resistant gloves, long-sleeve shirt, and long pants) [Table 2 scenario 1],
- mixing liquid formulations for groundboom and airblast applications (PPE: chemical-resistant gloves, long-sleeve shirt, and long pants) [Table 5 scenarios 1a and 1b],
- mixing wettable powder formulations for groundboom applications (PPE: chemical-resistant gloves plus coveralls worn over long-sleeve shirt and long pants) [Table 5 scenario 2],
- mixing wettable powder formulations packaged in water soluble packets for airblast applications (PPE: long-sleeve shirt, and long pants) [Table 2 scenario 2b],
- loading granulars for groundboom and aerial (350 acres only) applications (PPE: chemical-resistant gloves, long-sleeve shirt, and long pants), the loading of granulars at the maximum treatment area of 800 acres requires the use of "lock-and-load" equipment, long pants, long-sleeve shirt [Table 2 scenarios 3a and 3b], and

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- mixing dry flowables for groundboom and airblast applications (PPE: chemical-resistant gloves, coveralls over long-sleeve shirt, and long pants; coveralls not needed for the airblast mixer/loader) [Table 2 scenarios 4b and 4c].

OCCUPATIONAL APPLICATORS

- aerial applicators applying spray (Engineering Control: enclosed cockpit; PPE: long-sleeve shirt and long pants) [Table 2 scenario 5a],
- applicator using groundboom equipment to apply a spray (Engineering Control: enclosed cab; PPE: long-sleeve shirt and long pants) [Table 5 scenario 3],
- applicator using row or broadcast equipment to apply granular formulation (Engineering Control: enclosed cab; PPE: chemical-resistant gloves plus coveralls worn over long-sleeve shirt and long pants), and
- applicator using airblast sprayers (Engineering Control: enclosed cab; PPE: long-sleeve shirt and long pants) [Table 5 scenario 4].

OCCUPATIONAL MIXERS/LOADERS/APPLICATORS

- backpack sprayer application (PPE: long-sleeve-shirt and long pants) [Table 2 scenario 12],
- low-pressure handwand application (PPE: chemical-resistant gloves plus long-sleeve shirt and long pants) [Table 2 scenario 13],
- high-pressure handwand application -- minimum application rate only (PPE: chemical-resistant gloves plus coveralls over long-sleeve shirt and long pants and a dust/mist respirator) [Table 2 scenario 14].

FLAGGERS

- flaggers supporting aerial applications of spray or granular (PPE: coveralls over long-sleeve shirt and long pants and dust/mist respirator/long-sleeve shirt and long pants, respectively) [Table 2 scenarios 10 and 11].

MOEs LESS THAN TEN AT MAXIMUM FEASIBLE PROTECTION

- mixing wettable powder formulations for aerial application [Table 2 scenario 2a],
- mixing dry flowable formulations for aerial application [Table 2 scenario 4a],

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- high-pressure handwand application in nursery or greenhouse -- typical and maximum application rates [Table 2 scenario 14].

INSUFFICIENT DATA

- seed treatment applications
- dip applications
- tree-trunk spray applications

Risk From Post-Application Exposures

The results of the cauliflower and tomato study (MRID No. 429745-01) indicate that the **scouts** require no special reentry interval. Based on the post-application exposure data for **harvesters**, reentry intervals of 5, 22, and 34 days are required for low crops, medium crops, and high crops, respectively. The reentry interval was not calculated for grapes because at 35 days the MOE is still unacceptable (see table below). The daily dose, MOEs, and REIs are presented below for the scouts and harvesters reentering chlorpyrifos treated sites.

Daily Dose, MOEs, and REIs of Scouts Reentering Sites Treated with Chlorpyrifos

Crop	DAT	Daily Dose (mg/kg/day)[a]	MOE[b]	REI
Scouts (Actual Data)				
Cauliflower	0	0.061	49	Sprays have dried
Tomato	0	0.019	160	Sprays have dried

DAT = Days after treatment (after sprays have dried)

[a] Daily Dose (mg/kg/day) = $\frac{\text{Daily exposure (mg/day)}}{\text{70 kg body weight}}$

[b] Margin of Exposure (MOE) = NOEL/(Daily Dose * dermal absorption)

where:

NOEL = 0.03 mg/kg/day (human oral study)
Dermal absorption = 0.01

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Daily Dose, MOEs, and REIs of Harvesters Reentering Sites Treated with Chlorpyrifos

Crop	DAT	Daily Dose (mg/kg/day)[a]	MOE[b]	REI
Harvesters (Surrogate Data)				
Low Crops	5	0.2586	11.6	5
Medium Crops	22	0.2890	10.4	22
Grapes	35	1.3040	2.3	Not calculated
High Crops	34	0.2830	10.6	34

DAT = Days after treatment (after sprays have dried)

[a] Daily Dose (mg/kg/day) = $\frac{\text{Daily exposure (mg/day)}}{\text{70 kg body weight}}$

[b] Margin of Exposure (MOE) = NOEL/(Daily Dose * dermal absorption)

where:

NOEL = 0.03 mg/kg/day (human oral study)
Dermal absorption = 0.01

Additional Occupational/Residential Exposure Studies

Handler Studies

1. Handler exposure data are required to support the reregistration of mixing wettable powder formulations for aerial application, mixing dry flowable formulations for aerial application, applicator using airblast equipment, and high-pressure handwand application in nursery or greenhouse at the maximum application rate. Requirements for handler (mixer/loader/applicator) exposure studies are addressed in sections 231, 232, and 235 for dermal exposure, respiratory exposure, and biomonitoring, respectively in Subdivision U of the Pesticide Assessment Guidelines.

Post-Application Studies

The registrant must submit post-application exposure studies for chlorpyrifos uses on grapes, commerical sod farms, and commercial turf grass uses. Requirements for post-application exposure are addressed in sections 132-1, 133-3, and 133-4 for foliar residue dissipation, post-application dermal exposure, and post-application inhalation exposure, respectively. Guidelines 133-3 and 133-4 may be reserved at this time pending completion of the databases on agricultural and residential post-application/re-entry exposure currently

being developed by the Agricultural Reentry Task Force and Outdoor Residential Exposure Task Force, since the registrant since the registrant is a member of both Task Forces.

References:

1. LUIS Report. Chlorpyrifos. October 2, 1995.

2. Chlorpyrifos Labels: 62719-163, 39, 221, 23, 245, 34, 255.

3. Toxicology Endpoint Selection Document for Chlorpyrifos - Dated August 15, 1994.

4. HED Memorandum DP Barcode (D208579) entitled Human Oral and Dermal Absorption Pharmacokinetic Study, March 6, 1995.

ATTACHMENT

cc: John Redden, RCAB/HED
Dennis McNeilly, SRB/SRRD
B.F. Kitchens, OREB
Chemical File: Chlorpyrifos (059101)
Circulation
Correspondence

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ATTACHMENT

Exposure/Risk Tables 1-6

Table 1. Passive Dosimetry: Baseline Exposure Values for Agricultural Uses of Chlorpyrifos

Exposure Scenario (Number)	Baseline Dermal Unit Exposure[a] (mg/lb ai)	Baseline Inhalation Unit Exposure[b] (μg/lb ai)	Maximum Label Application Rate[c] (lb ai/acre)	Daily Max. Treated[d] (acres)	Daily Dermal Exposure[e] (mg/day)	Daily Inhalation Exposure[f] (mg/day)	Total Daily Exposure[g] (mg/day)
Mixer/Loader Exposure							
Mixing All Liquids for Aerial Application (1)	0.04	1.2	1.5	Min: 350 Max: 800	Min: 21.0 Max: 48.0	Min: 0.63 Max: 1.4	Min: 21.6 Max: 49.4
Mixing WP for Aerial Application (2a)	0.2	43.4	2.0	Min: 350 Max: 800	Min: 140 Max: 320.0	Min: 30.4 Max: 69.4	Min: 170.4 Max: 389.4
Mixing WP for Airblast Application (2b)			2.0	40	16.0	3.5	19.5
Loading Granulars for Aerial Application (3a)	0.003	1.7	1.95	Min: 350 Max: 800	Min: 2.0 Max: 4.7	Min: 1.2 Max: 2.7	Min: 3.2 Max: 7.4
Loading Granulars for Ground Application (3b)			4.35	80	2.1	0.59	2.7
Mixing Dry Flowables for Aerial Application (4a)	0.07	0.8	2.0	Min: 350 Max: 800	Min: 49.0 Max: 112.0	Min: 0.6 Max: 1.3	Min: 49.6 Max: 113.3
Mixing Dry Flowables for Groundboom Application (4b)			2.0	80	11.0	0.13	11.1
Mixing Dry Flowables for Airblast Application (4c)			2.0	40	5.6	0.064	5.7
Applicator Exposure							
Aerial (liquids) – Enclosed Cockpit (5a)	0.005	0.07	2.0	Min: 350 Max: 800	Min: 3.5 Max: 8.0	Min: 0.05 Max: 0.11	Min: 3.6 Max: 8.1
Aerial (granulars) – Enclosed Cockpit (5b)	0.002	1.3	1.95		Min: 1.4 Max: 3.1	Min: 0.89 Max: 2.0	Min: 2.3 Max: 5.1
Granular Row Planter (6)	0.1	11	4.35	80	35.0	3.8	38.8
Granular Broadcast Spreader (tractor) (7)	0.01	1.2	3.0	80	2.4	0.29	2.7
Seed Treatment (8)	No data	No data	No data	No data	No data	No data	No data
Dip Application (preplant peaches) (9)	No data	No data	No data	No data	No data	No data	No data
Flagger Exposure							
Liquids (10)	0.01	0.3	1.5	Min: 350 Max: 800	Min: 5.3 Max: 12.0	Min: 0.16 Max: 0.36	Min: 5.5 Max: 12.4
Granulars (11)	0.003	0.1	1.95		Min: 2.0 Max: 4.7	Min: 0.07 Max: 0.16	Min: 2.1 Max: 4.9
Mixer/Loader/Applicator Exposure							
Backpack Sprayer (12)	2.6	30	0.0417 lb ai/gal	40 gallons	4.3	0.05	4.4
Low Pressure Handwand (13)	104	31	0.0417 lb ai/gal	40 gallons	173.5	0.05	173.6
High Pressure Handwand (14)	3.4	117	Min: 0.25 lb ai/100 gal Typ: 1.0 lb ai/100 gal Max: 16 lb ai/100 gal	1,000 gallons	Min: 8.5 Typ: 34.0 Max: 544.0	Min: 0.29 Typ: 1.17 Max: 18.72	Min: 8.8 Typ: 35.2 Max: 562.7
Tree Trunk Spray (15)	No data	No data	No data	No data	No data	No data	No data

[a] The baseline dermal unit exposure for mixer/loaders represents long pants, long sleeve shirt, and chemical resistant gloves while open pour of liquids/WP/granulars/dry flowables. The baseline demal unit exposure for all applicators represent long pants, long sleeve shirt, and no gloves while using open cabs and enclosed cockpits for pilots (no open cockpit data available). The baseline dermal unit exposure for flaggers represents long pants, long sleeve shirt, and no gloves. The baseline dermal unit exposure for mixer/loader/applicators represents long pants, long-sleeve shirt, and no gloves.

[b] The baseline inhalation unit exposure values are for workers wearing no respirators while using open pour for mixer/loaders, enclosed cockpit for aerial applicators, and open cab for tractor drawn applications.

[c] Labels, Reg. Nos. 62719-163, 39, 221, 23, 245, 34; greenhouse label 62719-255.

[d] Values represent the maximum area or the maximum volume of spray solution which can be used in a single day to complete treatments for each exposure scenario of concern.

[e] Daily Dermal Exposure (mg/day) = Exposure (mg/lb ai) * Max. Appl. Rate (lb ai/acre or lb ai/gal) * Daily Max. Treated

[f] Daily Inhalation Exposure (mg/day) = Exposure (ug/lb ai) * (1 mg/1,000ug conversion) * Max. Appl. Rate (lb ai/acre or lb ai/gal) * Daily Max. Treated

[g] Total Daily Exposure (mg/day) = Daily Dermal Exposure (mg/day) + Daily Inhalatin Exposure (mg/day).

Table 2. Passive Dosimetry: Risks Associated with Baseline and Mitigation Measures for Agricultural Uses of Chlorpyrifos

Exposure Scenario (Scen. #)	Baseline Daily Absorbed Dermal Dose[a,b] (mg/kg/day)	Baseline Daily Inhalation Dose[b] (mg/kg/day)	Baseline Daily Absorbed Total Dose[b] (mg/kg/day)	Baseline Total MOE[c]	Risk Mitigation Measures					
					Additional PPE[d]			Engineering Controls[e]		
					Dermal Unit Exposure (mg/lb ai)	Daily Total Absorbed Dose[b] (mg/kg/day)	Total MOE[c]	Dermal Unit Exposure (mg/lb ai)	Daily Total Absorbed Dose[b] (mg/kg/day)	Total MOE[c]
Mixer/Loader Risk										
Mixing All Liquids for Aerial Application (1)	Min: 0.0030 Max: 0.0069	Min: 0.009 Max: 0.02	Min: 0.012 Max: 0.027	Min: 2.5 Max: 1.1	0.03	Min: 0.011 Max: 0.026	Min: 2.7 Max: 1.2	0.009 (gloves) (0.08)[f]	Min: 0.001 Max: 0.003	Min: 30 Max: 10
Mixing WP for Aerial Application (2a)	Min: 0.020 Max: 0.046	Min: 0.43 Max: 0.99	Min: 0.45 Max: 1.036	Min: 0.07 Max: 0.03	0.09	Min: 0.443 Max: 1.01	Min: 0.07 Max: 0.03	0.02 (0.24)[f]	Min: 0.004 Max: 0.010	Min: 7.5 Max: 3.0
Mixing WP for Airblast Application (2b)	0.0023	0.05	0.052	0.6	0.09 (respirator)	0.011	2.7		0.0005	60
Loading Granulars for Aerial Application (3a)	Min: 0.0003 Max: 0.0007	Min: 0.02 Max: 0.04	Min: 0.020 Max: 0.041	Min: 1.5 Max: 0.7	0.002 (respirator)	Min: 0.003 Max: 0.008	Min: 10 Max: 3.8	0.0001 (0.03)	Min: N/A Max: 0.0008	Min: N/A Max: 38
Loading Granulars for Ground Application (3b)	0.0003	0.008	0.008	3.8		0.002	15	N/A	N/A	N/A
Mixing Dry Flowables for Aerial Application (4a)	Min: 0.0070 Max: 0.016	Min: 0.009 Max: 0.02	Min: 0.016 Max: 0.036	Min: 1.9 Max: 0.8	0.04	Min: 0.012 Max: 0.027	Min: 2.5 Max: 1.1	See WP	See WP	See WP
Mixing Dry Flowables for Groundboom Application (4b)	0.0016	0.002	0.004	7.5		0.003	10	N/A	N/A	N/A
Mixing Dry Flowables for Airblast Application (4c)	0.0008	0.0009	0.002	15	N/A	N/A	N/A	N/A	N/A	N/A
Applicator Risk										
Aerial (liquids) -- Enclosed Cockpit (5a)	Min: 0.0005 Max: 0.0011	Min: 0.0007 Max: 0.002	Min: 0.001 Max: 0.003	Min: 30 Max: 10	Not appropriate	Not appropriate	Not appropriate	See baseline	See baseline	See baseline
Aerial (granulars) -- Enclosed Cockpit (5b)	Min: 0.0002 Max: 0.0004	Min: 0.01 Max: 0.03	Min: 0.010 Max: 0.030	Min: 3 Max: 1	Not appropriate	Not appropriate	Not appropriate	See baseline	See baseline	See baseline
Granular Row Planter (6)	0.0050	0.05	0.055	0.5	insufficient data	insufficient data	insufficient data	0.002 (0.2)[f]	0.001	30
Granular Broadcast Spreader (tractor) (7)	0.0003	0.0008 (respirator)	0.001	30	N/A	N/A	N/A	N/A	N/A	N/A
Seed Treatment (8)	No data	No data	No data	No data	No data	No data	No data	No data	No data	No data

Exposure Scenario (Scen. #)	Baseline Daily Absorbed Dermal Dose[a,b] (mg/kg/day)	Baseline Daily Inhalation Dose[b] (mg/kg/day)	Baseline Daily Absorbed Total Dose[b] (mg/kg/day)	Baseline Total MOE[c]	Risk Mitigation Measures					
					Additional PPE[d]			Engineering Controls[e]		
					Dermal Unit Exposure (mg/lb ai)	Daily Total Absorbed Dose[b] (mg/kg/day)	Total MOE[c]	Dermal Unit Exposure (mg/lb ai)	Daily Total Absorbed Dose[b] (mg/kg/day)	Total MOE[c]
Dip Application (preplant peaches) (9)	No data	No data	No data	No data	No data	No data	No data	No data	No data	No data
Flagger Risk										
Liquids (10)	Min: 0.0008 Max: 0.0017	Min: 0.002 Max: 0.005	Min: 0.003 Max: 0.007	Min: 10 Max: 4.3	Min: N/A Max: 0.007 (no gloves) (respirator)	Min: N/A Max: 0.002	Min: N/A Max: 15	N/A	N/A	N/A
Granulars (11)	Min: 0.0003 Max: 0.0007	Min: 0.001 Max: 0.002	Min: 0.001 Max: 0.003	Min: 30 Max: 10	N/A	N/A	N/A	N/A	N/A	N/A
Mixer/Loader/Applicator Risk										
Backpack Sprayer (12)	0.0006	0.0007	0.001	30	N/A	N/A	N/A	N/A	N/A	N/A
Low Pressure Handwand (13)	0.0248	0.0007	0.023	1.3	4.1 (no coveralls)	0.002	15	N/A	N/A	N/A
High Pressure Handwand (14)	Min: 0.0012 Typ: 0.0049 Max: 0.0777	Min: 0.004 Typ: 0.02 Max: 0.27	Min: 0.005 Typ: 0.025 Max: 0.348	Min: 6.0 Typ: 1.2 Max: 0.09	1.3 (respirator)	Min: 0.001 Typ: 0.006 Max: 0.084	Min: 30 Typ: 5.0 Max: 0.4	None	None	None
Tree Trunk Spray (15)	No data	No data	No data	No data	No data	No data	No data	No data	No data	No data

N/A-Not applicable, baseline MOE value is greater than the uncertainty factor of 10 (i.e., tox endpoint derived from a human volunteer study). Engineering controls are not available for the high pressure handwand.

[a] The baseline dermal unit exposure for mixer/loaders represents long pants, long sleeve shirt, and chemical resistant gloves while open pour of liquids/wp/granulars/dry flowables. The baseline demal unit exposure for all applicators represent long pants, long sleeve shirt, and no gloves while using open cab and enclosed cockpit for pilots (no open cockpit data available). The baseline dermal unit exposure for flaggers represents long pants, long sleeve shirt, and no gloves. The baseline dermal unit exposure for mixer/loader/applicators represents long pants, long-sleeve shirt, and no gloves.

[b] Daily Dose (mg/kg/day) = Daily Exposure (mg/day)/70 kg body weight (see Table 1 for Daily Exposures). The 1 percent dermal absorption is applied to the daily dose.

[c] MOE = NOEL / Daily Total Dose (mg/kg/day). Where: NOEL = 0.03 mg/kg/day (oral study, human volunteers).

[d] Additional PPE represents coveralls over long pants, long sleeve shirt, and chemical resistant gloves while using open systems. NOTE: The flagger (liquid) is not wearing gloves.

[e] Closed mixing of liquids, long pants, long sleeve shirt, and chemical resistant gloves. Water soluble packets for WP and long pants, long sleeve shirt, no gloves.

[f] Inhalation unit exposures for engineering controls, listed in parentheses, are in units of μg/lb ai handled.

Table 3. Exposure Scenario Descriptions of the Exposure and Risk Mitigation Measures for Agricultural Uses of Chlorpyrifos

Exposure Scenario (Number)	Data Source	Standard Assumptions[a] (8-hr work day)	Comments[b]
Mixer/Loader Exposure			
Mixing All Liquids (1a,b,c)	PHED V1.1 (DowElanco MRID Nos. 429745-01 and 431381-02)	range of 350 to 800 acres aerial; 80 acres groundboom; 40 acres airblast	**Baseline:** "Best Available" data. Dermal, inhalation and hand = acceptable grades. Dermal = 25 to 122 replicates; hands = 59 replicates; inhalation = 85 replicates. Dermal and inhalation high confidence in data. **Engineering Controls:** "Best Available" data. Dermal, inhalation and hand = acceptable grades. Dermal = 16 to 22 replicates; hands = 31 replicates; inhalation = 27 replicates. Dermal and inhalation high confidence in data. PHED data were used for Baseline and Engineering Controls, no protection factors (PFs) were necessary. For PPE a 50% PF was added for coveralls.
Mixing Wettable Powder (2a,b)	PHED V1.1 (DowElanco MRID No. 429745-01)	range of 350 to 800 acres aerial; 40 acres airblast	**Baseline:** "Best Available" data. Dermal = ABC grades, inhalation = ABC grades, Hand = all grades. Dermal = 22 to 45 replicates; hands = 24 replicates; inhalation = 44 replicates. Medium confidence in dermal data; inhalation medium confidence in data. **Engineering Controls:** "Best Available" data. Dermal, inhalation and hand = all grades. Dermal = 6 to 15 replicates; inhalation = 15 replicates; hands = 5 replicates. Low confidence in dermal and inhalation data. PHED data were used for Baseline and Engineering Controls, no PFs were necessary. For PPE a 50% PF was used for coveralls.
Loading Granulars (3a,b)	PHED V1.1	range of 350 to 800 acres aerial; 80 acres ground application	**Baseline:** "Best Available" data. Dermal, inhalation and Hands = acceptable grades. Dermal = 29 to 36 replicates; inhalation = 58 replicates; hands = 45 replicates. High confidence in dermal inhalation data. PHED data were used for Baseline, no PFs were necessary. For PPE a 50% PF was used for coveralls, for Engineering Controls, a 98% PF was added for a closed mixing/loading system.
Mixing Dry Flowables (4a,b,c)	PHED V1.1	range of 350 to 800 acres aerial; 40 acres airblast	**Baseline:** "Best Available" data. Dermal, inhalation and hands = acceptable grades. Dermal = 16 to 26 replicates; Inhalation = 23 replicates and Hands = 21 replicates. High confidence in dermal and inhalation data. PHED data were used for Baseline, no PFs were necessary. For PPE a 50% PF was used for coveralls, for Engineering Controls see wettable powders (scenario 2).
Applicator Exposure			

Exposure Scenario (Number)	Data Source	Standard Assumptions[a] (8-hr work day)	Comments[b]
Aerial equipment - enclosed cockpit (liquids) (5a)	PHED V1.1	range of 350 to 800 acres	**Baseline/Engineering Controls:** "Best Available" data. Dermal and inhalation = ABC grades; Hands = Acceptable grades. Dermal = 24 to 48 replicates; Inhalation = 23 replicates; Hands = 34 replicates. Medium confidence in dermal and inhalation data. PHED data were used for Baseline/Engineering Controls, no PFs were necessary.
Aerial equipment - enclosed cockpit (Granulars) (5b)	PHED V1.1	range of 350 to 800 acres	**Baseline/Engineering Controls:** "Best Available" data. Dermal, inhalation and hands = all grades. Dermal = 9 to 13 replicates; inhalation = 13 replicates; hands = 4 replicates. Low confidence in dermal and inhalation data. PHED data were used for Baseline/Engineering Controls, no PFs were necessary.
Granular Row Planter (6)	PHED V1.1	80 acres	**Engineering Controls:** "Best Available" data. Dermal, Inhalation and hands = acceptable grades. Dermal = 27 to 30 replicates; inhalation = 37 replicates; hands = 24 replicates. High confidence in dermal and inhalation data. PHED data were used for Engineering Controls. For Baseline data, a 98% PF was removed from the Engineering Controls data.
Granular Broadcast Spreader (7)	PHED V1.1	80 acres	**Baseline:** "Best Available" data. Dermal, inhalation and hands = acceptable grades. Dermal = 4 to 5 replicates; inhalation = 5 replicates; hands = 5 replicates. Low confidence in dermal and inhalation replicates. PHED data were used for Baseline, no PFs were necessary.
Seed Treatment (8)	No Data	No Data	No Data
Dip Application (Preplant Peaches) (9)	No Data	No Data	No Data
Flagger			
Liquids (10)	PHED V1.1	range of 350 to 800 acres	**Baseline:** "Best Available" data. Dermal, inhalation, and hands = acceptable grades. Dermal = 16 to 18 replicates; Inhalation = 18 replicates; hands = 16 replicates. High confidence in dermal and inhalation data. PHED data were used for Baseline, no PFs were neccessary. A 50% PF was added for PPE to represent coveralls.

Exposure Scenario (Number)	Data Source	Standard Assumptions[a] (8-hr work day)	Comments[b]
Granulars (11)	PHED V1.1	range of 350 to 800 acres	**Baseline:** "Best Available" data. Dermal, inhalation and hands = acceptable grades. Dermal = 16 to 18 replicates; inhalation = 4 replicates; hands = 4 replicates. Low confidence in dermal and inhalation data. PHED data were used for Baseline, a 50% PF for single layer clothing was applied to total deposition data from PHED.
Mixer/Loader/Applicator			
Backpack Sprayer (12)	PHED V1.1	occupational use of 40 gallons	**Baseline:** "Best Available" data. Dermal and hands = ABC grades; inhalation = acceptable grades. Dermal = 9 to 11 replicates; inhalation = 11 replicates; hands = 11 replicates. Low confidence in dermal and inhalation data. PHED data were used for Baseline, a 90% PF was removed to calculate a no glove scenario.
Low Pressure Handwand (13)	PHED V1.1	occupational use of 40 gallons	**Baseline:** "Best Available" data. Dermal, inhalation and hands = all grades. Dermal = 25 to 96 replicates; Inhalation = 96 replicates; hands = 70 replicates. Low confidence in dermal and inhalation data. **PPE:** "Best Available" data. Dermal = all grades; hands = acceptable grades. Dermal = 25 to 96 replicates; Hands = 15 replicates. Low confidence in dermal data. PHED data were used for Baseline and PPE, no PFs were necessary.
High Pressure Handwand (14)	PHED V1.1	1,000 gallons	**Baseline and PPE:** "Best Available" data. Dermal and hands grades ABC; inhalation acceptable grades. Dermal = 7 to 13 replicates; Hands = 13 replicates; Inhalation = 13 replicates. Low confidence in dermal and inhalation data. PHED data were used for Baseline, a 90% PF was removed for the no glove scenario. A 50% PF was used for the addition of coveralls for the PPE scenario.
Tree Trunk Sprayer (15)	No Data	No Data	No Data

Note: The Baseline exposure for mixer/loaders include chemical resistant gloves.

a Standard Assumptions based on an 8-hour work day as estimated by OREB. BEAD data were not available.

b "Best Available" grades are defined by OREB 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; and
Low = grades A, B, C, D, and E or any combination of grades with less than 15 replicates.

Table 4. Biological Monitoring for Agricultural Uses of Chlorpyrifos

Exposure Scenario (Number)[a]	Unit Dose[b] (mg/kg/lb ai)	Equipment Used	Clothing Scenario Monitored	No. of Obs.	Daily Dose[c] (mg/kg/day)	MOE[d]
Mixer/Loader Risk						
Mixing All Liquids for Groundboom Application (1a)	6.7×10^{-5}	Open pour liquids	Cotton coveralls over T-shirt and briefs, rubber boots, baseball cap, and chemical resistant gloves	3	0.016	1.9
Mixing All Liquids for Airblast Application (1b)	6.0×10^{-5}	Open pour liquids	Denim coveralls over short-sleeved shirt, long-pants, T-shirt and briefs, chemical resistant gloves, and a respirator	15	0.014	2.1
Mixing WP for Groundboom Application (2)	3.9×10^{-4}	Open pour wettable powder	Cotton coveralls over T-shirt and briefs, rubber boots, baseball cap, chemical resistant gloves, and 1/2 face respirator	6	0.062	0.48
Applicator Risk						
Groundboom Tractor (3)	6.1×10^{-5}	Open cab groundboom tractor	Cotton coveralls over T-shirt and briefs, and baseball cap	9	0.015	2.0
Airblast (4)	9.1×10^{-5}	Open cab airblast tractor	Denim coveralls over short-sleeved shirt, long-pants, T-shirt and briefs, chemical resistant gloves, and a respirator	15	0.022	1.4
Mixer/Loader/Applicator Risk						
Low Pressure Handwand (Greenhouse) (5)	1.7×10^{-5}	Gilmour 101P, manual sprayer	Cotton coveralls over T-shirt and briefs, rubber boots, baseball cap, and chemical resistant gloves	1	(H) 0.00028 (O) 0.00071	(H) 107 (O) 42
Backpack (Greenhouse) (6)	2.7×10^{-5}	Solo backpack sprayer	Cotton coveralls over T-shirt and briefs, rubber boots, baseball cap, and chemical resistant gloves	2	(H) 0.0011 (O) 0.0045	(H) 27 (O) 6.7
High Pressure Handwand (Greenhouse) (7)	3.7×10^{-5}	High pressure handwand sprayer	Six of the 13 test subjects wore neoprene rain jacket/pants, 1/2 face respirator, face shield, cotton coveralls over T-shirt and briefs, and chemical resistant gloves. The remaining 7 test subjects wore cotton coveralls over T-shirt and briefs, and chemical resistant gloves.	13	Min. 0.0093 Typ. 0.037 Max. 0.59	Min. 3.2 Typ. 0.81 Max. 0.051

Note: (H) = homeowner, (O) = occupational worker

[a] Data source for exposure scenarios 1a, 2, 3 is MRID No. 429745-01; exposure scenarios 1b and 4 is MRID No. 431381-02; and exposure scenarios 5, 6, and 7 is MRID No. 430279-01.

[b] All Unit Dose values are reported as the arithmetic mean.

[c] Daily Dose (mg/kg/day) = Unit Dose (mg/kg/lb ai) x Maximum daily treated x Maximum label rate. Maximum daily treated and label rates are reported in Table 1.

[d] MOE = NOEL / Daily Dose (mg/kg/day). NOEL = 0.03 mg/kg/day (oral study, human volunteers).

Table 5. Biological Monitoring Mitigation Measures for Agricultural Uses of Chlorpyrifos

Exposure Scenario (Number)[a]	Baseline Daily Dose (mg/kg/day)	Baseline MOE	Risk Mitigation Measures				
			Engineering Controls[c]			Mitigated Daily Dose and MOEs[d]	
			Type Mitigation	Protection Factor	Unit Exposure[b] (mg/kg/lb ai)	Daily Dose (mg/kg/day)	MOE
Mixer/Loader Risk							
Mixing All Liquids for Groundboom Application (1a)	0.016	1.9	Closed Mixing	98%	1.3×10^{-6}	0.0003	93
Mixing All Liquids for Airblast Application (1b)	0.014	2.1	Closed Mixing	98%	1.2×10^{-6}	0.0003	104
Mixing WP Groundboom Application (2)	0.062	0.48	WSB	98%	7.8×10^{-6}	0.001	24
Applicator Risk							
Groundboom Tractor (3)	0.015	2.0	Enclosed Cabs	98%	1.2×10^{-6}	0.0003	102
Airblast (4)	0.022	1.4	Enclosed Cabs	98%	1.8×10^{-6}	0.0004	69
Mixer/Loader/Applicator Risk							
Low Pressure Handwand (Greenhouse) (5)	(H) 0.00028 (O) 0.00071	(H) 107 (O) 6.7	N/A	N/A	N/A	N/A	N/A
Backpack (Greenhouse) (6)	(H) 0.0011 (O) 0.0045	(H) 27 (O) 6.7	N/A	N/A	N/A	N/A	N/A
High Pressure Handwand (Greenhouse) (7)	Min. 0.0093 Typ. 0.037 Max. 0.59	Min. 3.2 Typ. 0.81 Max. 0.051	N/A	N/A	N/A	N/A	N/A

Note: (H) = homeowner, (O) = occupational worker. N/A - Not applicable, engineering controls are not feasible.

[a] Data source for exposure scenarios 1a, 2, 3 is MRID No. 329745-01; esposure scenarios 1b and 4 is MRID No. 431381-02; and expsure scenarios 5, 6, and 7 is MRID No. 430279-01.

[b] See Table 2a for baseline unit dose.

[c] The type of engineering control and the accompanying protection factor is applied to the baseline unit dose.

[d] Daily Dose = Risk Mitigation Unit Dose x Max Application Rate x Max Daily Acres. Max daily acres treated and label rates reported in Table 1. MOE = NOEL/Daily Dose. NOEL = 0.03 mg/kg/day (human oral dosing study).