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DATE: August 22, 2022

SUBJECT: PROPANIL MITIGATION SCOPING DOCUMENT

Attached is a mitigation scoping document for registered pesticide products containing propanil as an active ingredient. Certain data were not yet available when Department of Pesticide Regulation was preparing its 2019 Risk Characterization Document (RCD). Thus, all actively registered labels were reviewed, as well as current pesticide use data, sales data, illness data, and other pertinent information. The attached scoping document serves to update the data within the 2019 RCD.

If you have any comments or questions, please contact me at the number listed above.

Attachment

California Environmental Protection Agency
Department of Pesticide Regulation
Worker Health and Safety Branch

HSM-22002

PROPANIL MITIGATION SCOPING DOCUMENT

August 22, 2022

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SUMMARY

This mitigation scoping document provides additional information and data that were not yet available during the completion of DPR's Propanil Risk Characterization Document (RCD) (Lohstroh, 2019). The updated scoping data show that propanil use patterns, labeling restrictions, and illness rates have remained similar to previous years that were included in the RCD. Therefore, the updated scoping data are consistent with the conclusions of the RCD.

PURPOSE

Propanil is a broad-spectrum, contact, post-emergence herbicide that is applied as a broadcast spray by ground/aerial equipment. The mode of action is disrupting photosynthesis in plants utilizing photosystem II. Propanil is the most widely used herbicide on California rice crops and is currently ranked within the top 20 agricultural pesticides used in the United States when assessed in terms of pounds of active ingredient (AI) applied (Lohstroh, 2019). Regulated at both the state and federal level, the only approved use of propanil is for the agricultural control of broad-leafed weeds, grasses, and aquatic weeds in rice fields.

Propanil was given a high-priority status for risk assessment by the California Department of Pesticide Regulation (DPR) due to studies revealing hematologic toxicity in dogs and mice, testicular and liver tumors in rats and lymphoma in mice, and concerns relating to residential bystander exposure to spray drift from application sites. Thus, DPR initiated the RCD in 2012—the same year that propanil was identified as a potential groundwater contaminant.

The RCD addressed the potential for human health effects arising from exposure to propanil in food and drinking water, from occupational activities, and from residential bystander exposure to spray drift. Aggregate risk was also evaluated for workers (i.e., handlers and fieldworkers) and residential bystanders.

This mitigation scoping document spans a period of eight years (2012–2019). While most of the information in the recently completed RCD is up to date, additional data is provided in this document. This scoping document contains all available Pesticide Use Reporting (PUR) data and pesticide sales data from 1990 to current, which were not yet available at the completion of the RCD. Additionally, since the completion of the RCD, the only two propanil-based products with human flagger (for aerial applications) information on their label are no longer registered in California. Thus, human flagger scenarios included in the RCD are not included in this scoping document. All potential exposure scenarios (dietary, residential bystander, occupational and aggregate) were identified in the RCD. This document does not identify additional exposure scenarios.

The purpose of this scoping document is to expand on all information relevant to the development of mitigation measures, if needed.

REGULATORY HISTORY AND STATUS

The first propanil-based herbicide products, Rogue Herbicide by Monsanto Co. and Stam F-34 by Dow Agrosciences LLC, were registered in 1962 by the United States Environmental Protection Agency (U.S. EPA). That same year, they were also registered in California. Current registrants include Innvictis Corp Care, LLC; Makhteshim Agan of North America Inc.; Solera Ato, LLC; United Phosphorus, Inc.; and Willowood, LLC (DPR, 2022a).

Current Regulatory Status

Table 1 summarizes some key aspects of propanil's current regulatory status.

Table 1. California Laws and Regulations Applicable to Propanil

	Restricted Material	Toxic Air Contaminant	Groundwater Protection List	Proposition 65 List
Yes/No	Yes	No	Yes	No
Laws	FAC Div. 7, Ch. 3, Art. 1, Sec. 14001	FAC Div. 7, Ch. 3, Art. 1.5, Sec. 14021 (b)	FAC Div. 7, Ch. 2, Art. 15, Sec. 13141	HSC, Sec. 25249.5
Regulations	3 CCR, Div. 6, Sec 6400	3 CCR, Div. 6, Sec 6860	3 CCR, Div. 6, Sec. 6800(b)	27 CCR, Sec. 25000 to 27001

FAC: California Food and Agriculture Code
HSC: California Health and Safety Code
CCR: California Code of Regulations

In accordance with parameters specified in the Pesticide Contamination and Prevention Act of 1985, propanil is designated as a potential groundwater contaminant (3 CCR Section 6800(b)). Also classified as a restricted-use herbicide, propanil may only be purchased, possessed, and used by licensed applicators; there are no approved residential uses.

U.S. EPA Registration Eligibility Decision (RED), 2003

In 2003, U.S. EPA completed an RED for propanil. The major findings of the RED concluded that there was "no unreasonable risk to residential bystanders and general population." However, occupational exposure risks were found to be above acceptable levels and a variety of risk mitigation measures were suggested for the continued use of propanil (U.S. EPA, 2003). Additionally, in 2003, U.S. EPA accepted requests from registrants for the voluntary cancelation of uses on small grains. In 2006, U.S. EPA revised the mitigation practices suggested in the RED after reviewing public comments and additional data from the Propanil Task Force II (U.S. EPA, 2006).

U.S. EPA Draft Risk Assessment, 2019

U.S. EPA released its draft risk assessment in November 2019. US. EPA's Health Effects Division (HED) identified no human health risks of concern resulting from dietary, aggregate, non-occupational spray drift at the field edge, or occupational exposures to propanil. HED also determined that assessments were not required for residential exposures to propanil, as there are no approved residential uses. Further, HED determined that cumulative observations were not required, as there are no known toxic metabolites for propanil (U.S. EPA, 2019; U.S. EPA, 2020).

Incidental oral and dietary risk assessments determined a Margin of Exposure (MOE). The MOE is the ratio of the no-observed-effects-level (NOEL) over an estimated human exposure. The NOEL for propanil was determined based on treatment-related effects in toxicity studies on rats. When determining MOEs, the standard practice assumes that humans are 10 times more sensitive than rats and assumes a 10-fold variation in the sensitivity of humans. Then a 3X Food Quality Protection Act (FQPA) safety factor is included because the point of departure (POD) for these exposures was based on a lowest-observed adverse effect level (LOAEL) from a chronic/carcinogenicity study in rats. However, the occupational risk assessment determined an MOE of 30 because the inhalation human equivalent concentration was calculated using a no-observed adverse effect concentration (NOAEC). All inhalation exposures resulted in short- and intermediate-term MOEs ranging from 120 to 210,000 with baseline attire, which the EPA defines as "long-sleeved shirt, long pants, shoes and socks" (U.S. EPA, 2019). Given the target MOE of 30, these risk estimates were not of concern. A post-application exposure assessment was deemed unnecessary, as handler exposure estimates would likely be higher and would be protective of most occupational post-application inhalation exposure scenarios.

US. EPA is in the process of determining additional policies for assessing risks to non-occupational bystanders from volatilization of applied pesticides. HED has also made recommendations to update several existing dietary tolerances for propanil for eggs and milk, and for fat, meat, and meat byproducts from poultry and livestock (U.S. EPA, 2020).

U.S. EPA Proposed Interim Decision (PID), 2020

Although U.S. EPA did not identify any human health risks of concern resulting from dietary, aggregate, non-occupational spray drift at the field edge, or occupational exposures to propanil, in order to address potential risks of concern to non-target organisms, U.S. EPA completed its proposed interim decision in September 2020, recommending that labels be amended to update mandatory and advisory spray drift management language, add a non-target organism advisory statement, and an environmental hazard statement for birds (U.S. EPA, 2020). U.S. EPA is also proposing label changes to address generic labeling requirements for all propanil products and uses. This includes a ground water advisory, as propanil may leach where soils are permeable or if used prior to flooding. There also must be language around herbicide resistance management that follows guidelines set by US EPA PRN-2017 and PRN 2017-2. All technical registrants have agreed to the proposed label changes (U.S. EPA, 2020).

Exposure Assessment Document (EAD), 2014

DPR's comprehensive Exposure Assessment Document (EAD) evaluated occupational (Table 8 and Table 9), non-occupational, and aggregated exposure scenarios (Table 10), resulting from propanil's use, which are summarized in the RCD (Zhao, 2018).

Risk Characterization Document (RCD), 2019

DPR's Propanil RCD, completed in February 2019, evaluated the risks to human health resulting from occupational, spray drift, dietary, and aggregate exposures to propanil (Lohstroh, 2019). The RCD concluded that all acute, seasonal, and annual worker scenarios produced margin of exposure (MOE) of less than 300, indicating insufficient health protection under those scenarios (Lohstoh, 2019). Moreover, some MOEs were as low as one. All dietary scenarios and residential bystander scenarios exceeded the target MOE of 300. Additional conclusions and key takeaways from the RCD include:

Potential Exposure Scenarios

As detailed in the RCD, potential exposures comprise:

- Occupational handlers (pilots, mixers, loaders, applicators, flaggers[1]) and fieldworkers.
- Residential bystander (those in the path of potential drift).
- Dietary (food and water).
- Aggregate (any combination of exposures).

Hazard Identification and Endpoints Evaluated in the RCD

Pharmokinetics:

- Rat: Both absorption and elimination of propanil approximately 100%.
- Humans: Observed bioconversion variable; possibly due to genetic variability relating to esterase activity, bioavailability, and/or saturation of N-hydroxylation reaction.

Acute Dermal Toxicity:

- Human: Acute lethal dose estimated at 1g/kg/day.
- LD_{50}: 779 – 1384mg/kg.

Subchronic and Chronic Toxicity:

- Subchronic: Rat, mouse, dog, rabbit: "increased mortality, cyanosis, lethargy, piloerection, lacrimation with ocular discharge, decreased defecation, mucoid feces with red material, decreases in total body weight, body weight gain rates, and food consumption, changes in hematologic parameters, macroscopic and microscopic signs of organ toxicity in the lungs, spleen, kidneys, liver, ovaries, and testes, and changes in blood chemistry and urinalysis parameters. Cyanosis, lethargy, changes in hematology and serum biochemistry, and splenic pathology were consistent with metHb formation and hemolytic anemia."
- Chronic: Three tumor types were significantly increased with chronic dietary propanil treatment; testicular interstitial tumors (rat), hepatocellular adenomas (rat and mouse), and lymphoma (mouse).

Dermal Toxicity:

- Rabbit: Moderate skin and eye irritant.
- Guinea pig: No effect.

Reproductive Toxicity:

- Decreased sperm and primordial follicles.
- Exposed rat pups: reduced body weight, increased testes and liver weights and delayed balanopreputial separation and vaginal perforation.

Developmental Toxicity: No developmental effect other than those to pups, detailed previously, when exposed through gestation and lactation.

[1] Flagger exposure scenarios were assessed in the RCD; at that time, two of the registered propanil products did not explicitly prohibit human flagging on the label. Since then, the California registrations for those products became inactive; all currently registered products in California prohibit human flagging. The flagger scenarios are not included in this scoping document as they are no longer exposures of concern and thus, do not require mitigation.

Genotoxicity: Inconclusive but limited evidence for propanil-induced genotoxic activity, which may be mediated by one or more of its metabolites.

Oncogenicity:

- Rats/mice: Tumors considered to have arisen from genotoxic mode of action (lymphoma, hepatocellular adenomas) did not have sufficient data for low-dose extrapolation.
- Testicular interstitial tumors believed to have an endocrine mode of action.
- POD based on endocrine effects expected to be protective of only testicular tumors.

Endocrine Effects: Evidence suggested that testicular interstitial tumors in male rats resulted from the mediated disruption of endocrine signaling.

Immunotoxicity: Increased splenic antibody production (IgM).

Target Levels for Acceptable Risk

Target levels of exposure (i.e., 300) were determined using hematologic toxicity results and uncertainty factors (UF) that incorporated intraspecies variations (10x), interspecies variations (10x), and enhanced genetic sensitivities (3x) (Table 8). A summary of critical PODs identified in the RCD (Lohstroh, 2019) is provided in Table 2.

Table 2. Summary of Critical PODs for Propanil

Exposure Route and Duration	Critical Endpoint and Study	PODs[a] (mg/kg/day)	RfDs[c] (mg/kg/day)
Acute/All Routes	Increased metHB levels (m) (day 5; rat)	BMDL $1SD^b$= 14.1	0.05 UFtotal = 300[c]
Subchronic/All Routes	Increased metHb levels (m) (week 13; rat)	BMDL $1SD^b$= 5	0.02 UFtotal = 300[c]
Chronic/All Routes	Hemosiderosis of spleen (m) (total; rat)	BMDL 10^b = 1.5	0.005 UFtotal = 300[c]

[a] As defined by U.S. EPA (2012), a POD is the dose-response point that marks the starting point for low-dose extrapolation, and generally corresponds to a select, estimated, low-level of response. In this RCD, the critical PODs for propanil are based on hematologic toxicity and are defined as an increased methemoglobin (metHB) level by one standard deviation compared to control levels or as a 10% increased incidence of hemosiderosis in the spleen.

[b] Benchmark Dose Lower Confidence Limit (BMDL): a value representing a 95% lower bound of the BMD and a POD for the observed effect; subscripts indicate an effect threshold based on data for concurrent controls (1SD = 1 standard deviation; 10 = 10% extra risk).

[c] Reference Dose (RfD): For propanil, the total uncertainty factors (UFtotal) used here are 10x for interspecies sensitivity and 10x for intraspecies variability and 3x for potentially enhanced sensitivity to metHb formation in infants and subpopulations with hereditary enzymatic deficiencies.
(Total UF = 300): RfD = (POD ÷ UF of 300).

Summary of Risk Characterization

When characterizing risk, DPR assumed humans to be ten times more sensitive than lab animals and people within the population to be ten times more sensitive, thus determining an MOE of 100. In order to account for vulnerable populations, such as infants or adults with enzyme deficiencies, the MOE is multiplied by 3 resulting in a target MOE of 300. All acute MOEs for herbicide handler/applicator scenarios (1 to 15) and for scouting (15) and weeding (233) were

lower than the target MOE (300) (Table 11 and Table 12). DPR also calculated the aggregate exposure, which included combining potential routes of oral exposure from food and water with occupational exposure. Based on these calculations, DPR has concerns for occupational risks and aggregate risks to workers.

Occupational Exposure and Risk: (Table 11 and Table 12)

Acute

- Acute scenarios used a critical acute POD of 14.1 mg/kg/day.
- Handler and fieldworker MOEs ranged from 1 to 15; below the target (300).

Seasonal

- Seasonal scenarios used critical subchronic POD of 5 mg/kg/day.
- Handler and fieldworker MOEs ranged from 1 to 74; below the target (300).

Annual

- Annual scenarios used a critical chronic POD of 1.5 mg/kg/day.
- Handler and fieldworker MOEs ranged from 2 to 133; below the target (300)

Residential Bystander Exposure and Risk: (Table 13, Table 14, and Table 15)

- Adult dermal MOEs exceed the target (300) for fixed wing and rotary winged aircraft applications in all scenarios greater than 50 ft. and 25 ft., respectively.
- All adult inhalation MOEs exceeded the target (300) for all aerial scenarios.
- Child dermal MOEs exceeded the target (300) for aerial applications scenarios greater than 50 ft.
- Child inhalation MOEs exceeded the target (300) for all aerial application scenarios.
- All adult and child dermal, inhalation and oral MOEs exceeded the target (300) for all ground boom application scenarios.

Aggregate Exposure and Risk:

Workers

- MOEs for handlers and fieldworkers ranged from 1 to 233.
- MOEs were less than target (300) for all application scenarios for handlers and fieldworkers (Table 16).

Residential Bystanders

- Aggregate MOEs for females of childbearing age (13 to 50 years old) exceeded the target (300) for all fixed wing and rotary winged aircraft application scenarios with downwind distances greater than 50 ft. and 25 ft., respectively, and all ground boom application scenarios (Table 17 and Table 18).
- Aggregate child MOEs exceeded the target (300) for all aerial applications greater than 50 ft. and all ground boom application scenarios (Table 19 and Table 20).
- Relative contribution of the dietary MOE component increased as the down-wind distance from the application site increased.

Dietary and Drinking Water Exposure and Risk:

Deterministic

- Estimated exposures ranged from 0.36 to 1.75 µg/kg/day and from 0.67 to 3.24 µg/kg/day for the 95th and 99th percentiles, respectively.
- POD of 14.1 mg/kg/day resulted MOEs of 8,040 to 39,399; exceeding the target (300) (Table 21).

Probabilistic

- Estimated exposures ranged from 0.11 µg/kg/day (adults, 50-99 years) to 0.44 µg/kg/day (non-nursing infants).
- POD of 1.5 mg/kg/day resulted in MOEs of 3,446 to 13,945; exceeding the target (300) (Table 22).

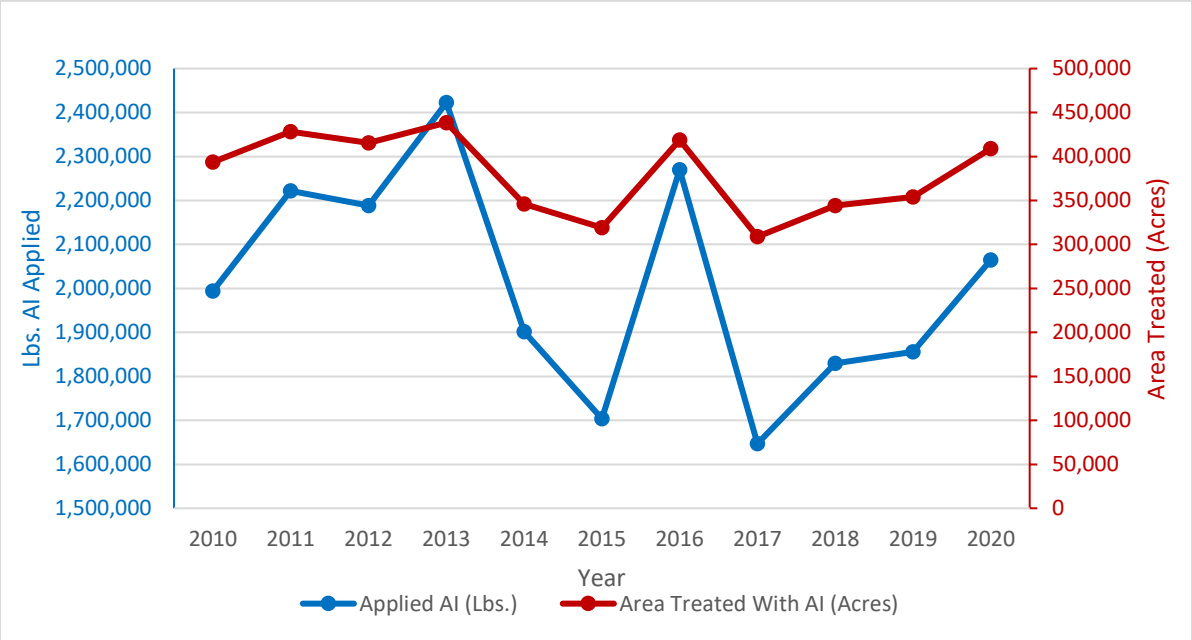
PESTICIDE USE AND SALES

The only approved use of propanil in California is as an herbicide in agricultural rice production. All available PUR data and pesticide sales data from 2010 to 2020 are given below (Table 3 and Figure 1). The use of propanil in California has increased steadily since 1990 with the largest increases associated with the formation of an Expanded Use Area (EUA) in 1997, which included Butte, Colusa, Glenn, Placer, Sutter, Yolo, and Yuba counties. The EUA allowed ground applications of propanil throughout the Sacramento Valley and aerial applications under certain conditions in a Butte County Study Area, which included several orchards in Butte and Glenn counties (Barry, 2012; DPR, 2022b). However, this limited use in orchards has not been observed since 2018. The use of propanil peaked in 2013 at 2.4 million pounds of AI used to treat 438,515 acres. Pounds of AI applied dipped in 2014 and 2015, peaked again in 2016 at 2.7 million pounds, then dropped to 1.6 million pounds in 2017. Propanil use then increased in 2018 and 2019 to 2.1 million pounds of AI applied in 2020 (most recent data available).

Table 3. Summary of California Propanil Use Data

Year	Applied AI (Lbs.)	Area Treated with AI (Acres)
2010	1,994,264	393,611
2011	2,222,043	428,345
2012	2,188,281	415,352
2013	2,422,565	438,515
2014	1,901,592	345,985
2015	1,703,709	318,915
2016	2,270,238	418,837
2017	1,647,035	308,806
2018	1,829,470	344,317
2019	1,855,890	354,193
2020	2,065,019	408,790

Figure 1. Amount of Propanil Applied and Area Treated from 2010-2020



Counties with the highest use of propanil from 2015-2020 were Colusa, Sutter, Butte, and Glenn, accounting for 83% of the state's total yearly application of over 11.3 million pounds (DPR, 2022b). The average percent of agricultural rice acreage treated with propanil in California was calculated from PUR data and United States Department of Agriculture (USDA) harvest data (USDA, 2019; DPR, 2022b) Based upon this data, an average of 358,976 acres were treated from 2015 to 2020, while an average of 487,333 acres were harvested. Based on use data, 74% of agricultural rice harvested was treated with propanil in California from 2015 to 2020 (Table 5). Average yearly pesticide use increased with acres treated by county (Table 4 and Figure 2). The ten counties with the most propanil use are indicated in Table 4 and Figure 2 below. Nearly all propanil applications occur in June and July (Figure 3).

Table 4. Average Pounds of Propanil Used and Acres Treated per Year in Top 10 Counties (2015-2020)

County	Average Acres Treated/Year	Average Lbs./Year
COLUSA	87,180.27	477,918.79
SUTTER	76,940.49	405,959.98
BUTTE	71,574.49	369,118.07
GLENN	61,445.45	312,569.16
YUBA	26,407.72	138,015.96
YOLO	17,066.24	94,517.59
PLACER	7,540.83	39,515.75
SACRAMENTO	6,356.38	35,862.67
SAN JOAQUIN	2,206.83	11,889.80
MERCED	1,153.24	4,996.13
Total Average Yearly Use	357,871.94	1,890,363.90

Figure 2. Average Pounds of Propanil Used and Acres Treated per Year in Top 10 Counties (2015-2020)

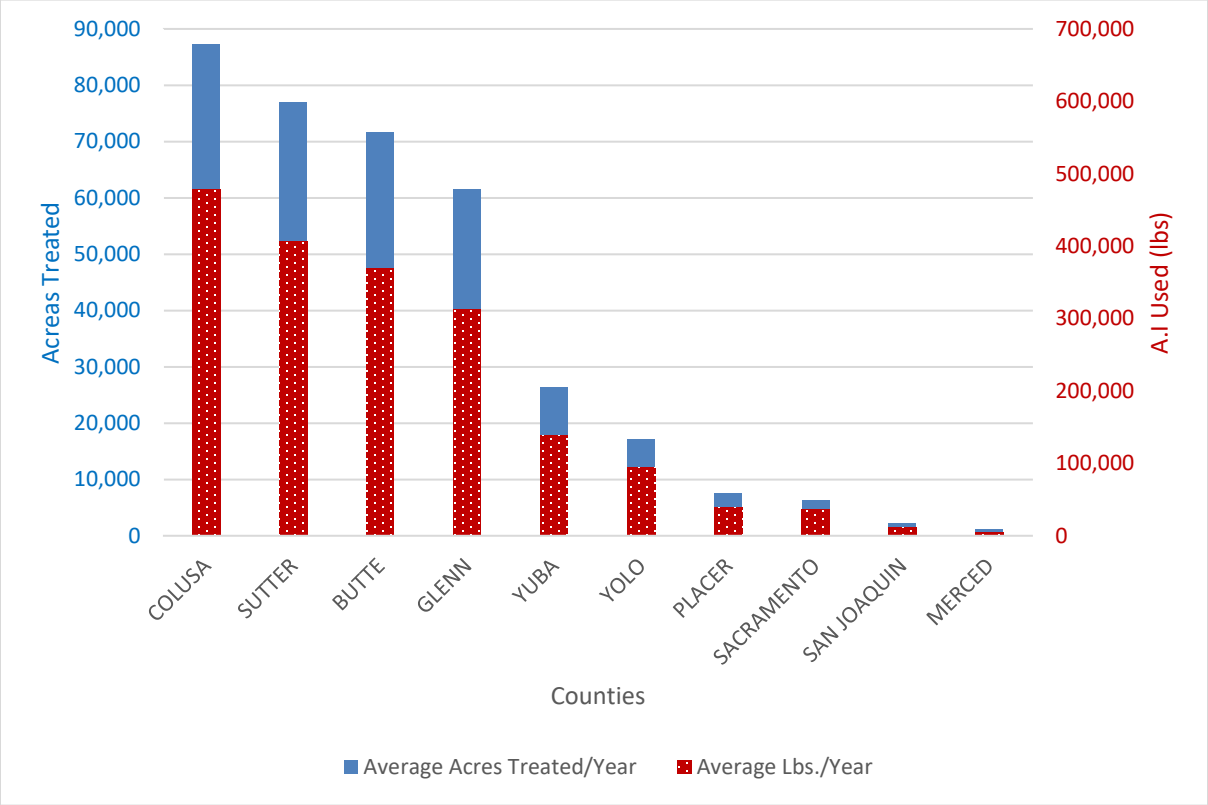
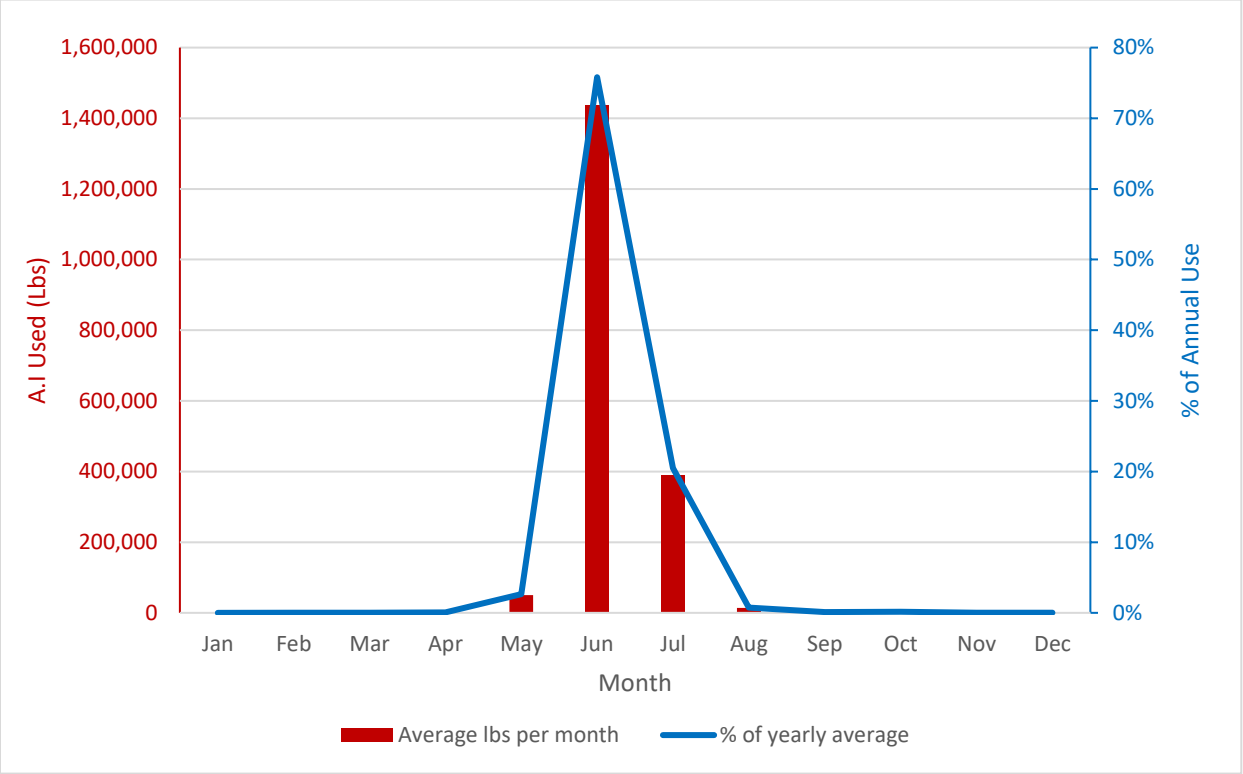


Table 5. Percent of Harvested Rice Acreage Treated with Propanil

Year	Area Treated	Area Harvested	% Treated of harvested	Area Planted	% Treated of planted
2015	318,914.93	426,000	75%	429,000	74%
2016	418,837.17	536,000	78%	541,000	77%
2017	308,805.93	443,000	70%	445,000	69%
2018	344,317.01	504,000	68%	506,000	68%
2019	354,193.43	501,000	71%	503,000	70%
2020	408,790.37	514,000	80%	517,000	79%
Avg	358,976.47	487,333	74%	490,167	73%

Figure 3. Pounds Applied and Relative Percentage of Annual Use of Propanil in California (2015 – 2020)



PRODUCTS AND FORMULATIONS

Propanil is formulated as an aqueous concentrate (40.2-58.6% AI), flowable concentrate (41.2% AI), and dry flowable concentrate (81% AI) (DPR, 2022c). In California, propanil is formulated alone or with halosulfuron-methyl (HSM) (0.46% AI). There are currently 5 registrants for 8 registered propanil products in California (DPR, 2022a). A complete list of the registrants and all actively registered products in California is provided below (Table 6).

Table 6. Registrants and Actively Registered Products Containing Propanil

Registrant	Product Names	EPA Reg #	Formulation	% AI
Innvictis Crop Care, LLC	Virtue 4SC	89168- 13-AA- 89391	Liquid Concentrate	41.4%
Makhteshim Agan of North America, Inc.	Diverge Silk	66222- 286-AA	Aqueous concentrate	40.2%
Solera Ato, LLC	Solanil 80EDF Herbicide	94123- 2-AA- 84237	Dry Flowable	81.0%

Registrant	Product Names	EPA Reg #	Formulation	% AI
United Phosphorus, Inc.	Stam 80 EDF-CA Herbicide	70506- 375-AA	Soluble Powder	81.0%
United Phosphorus, Inc.	Superwham! CA	70506- 359-AA	Flowable Concentrate	41.2%
Willowood, LLC	Willowood Propanil 4SC	87290- 18-AA	Aqueous Concentrate	58.6%
	Willowood Propanil 4SC (CA)	87290- 18-ZA	Aqueous Concentrate	41.4%
	Willowood Propanil 80CHS	87290- 17-ZA	Dry Flowable	81.0%

LABEL REQUIREMENTS AND RESTRICTIONS

Table 7. Label Requirements and Restrictions for Products Containing Propanil

	Label Requirements
PPE	• Coveralls over short-sleeved shirt and long pants • Chemical-resistant gloves made of barrier laminate or butyl rubber >14 mils • Chemical-resistant footwear plus socks • Protective eyewear (goggles/face shield) • Chemical-resistant gloves made of waterproof material and chemical-resistant apron when mixing/loading, cleaning up spills or equipment, or otherwise exposed to the concentrate. • For overhead exposure, wear chemical-resistant headgear. • When mixing/loading/cleaning equipment, wear a chemical-resistant apron.
PPE (Pilots and handlers removing probe)	• Long-sleeved shirt and long pants • Shoes plus socks • Chemical-resistant gloves made of barrier laminate or butyl rubber >14 mils
Signal Word(s)	Caution, Warning
Restricted Material	Yes, Federal and California restricted materials
Maximum Application Rate	• 6 lbs AI per acre per application • 8 lbs AI per acre per season
REI	24 hrs

The following activities are prohibited:

- Use of human flaggers.
- Application of products through irrigation.
- Application of products to any crop other than rice.
- Use on wild rice.
- Planting or transplanting of crops in the treated area for at least 60 days following treatment.

- Use of air-assisted (air blast) sprayers.
- Use of water drained from treated fields to irrigate other crops, or release of water from treated fields within ½ mile upstream of a potable water intake in flowing water or within ½ mile of a potable water intake in a standing body of water.
- Use at temperatures in excess of 90°F.
- Use when wind conditions will allow drift to adjacent crop(s).
- Grazing of treated fields within 60 days after last application.
- Application within 69 days of harvest in California.
- Application within 14 days, before or after, insecticide applications.

PESTICIDE ILLNESS REPORTS

DPR's Pesticide Illness Surveillance Program (PISP) database defines a "case" as a representation of an individual's exposure to a pesticide(s) that may or may not result in an illness and injury.

From 1992-2018, the most recent data available, PISP reported one propanil exposure case. The incident involved an applicator applying cyhalofop butyl, propanil, and triclopyr herbicides in Sutter County (DPR, 2022c). Symptoms were nausea and dizziness. It should be noted that although PISP has not confirmed any additional cases, U.S. EPA's Incident Data System reports two "minor" incidents involving propanil alone, and one "moderate" incident involving propanil and more than one AI (U.S. EPA, 2015). Ten incidents of low severity were reported by the Centers for Disease Control's National Institute for Occupational Safety and Health, Sentinel Event Notification System for Occupational Risk-Pesticides (Sensor) (U.S. EPA, 2015). One of these cases involved propanil as the only AI; the other nine involved at least one other AI.

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APPENDIX

This appendix includes all occupational exposure scenarios (Tables 8 and 9) and non-occupational and aggregated exposure scenarios (Table 10) that were evaluated in the EAD. It also includes all corresponding MOEs calculated in the RCD, where MOEs below the target of 300 are shaded (Tables 11-21).

Table 8. Handler Exposure Scenarios for Propanil Agricultural Applications[a] Back

Activity[b]	Formulation[c]	Application Method	Crop/Site	Maximum Use Rate (lb. AI/acre)[d]	Typical Use Rate (lb. AI/acre)[e]	Maximum Acres Treated per Day[f]	Typical Acres Treated per Day[f]
1a. M/L	DF	Ground boom	Rice	6.0	3.0	200	80
1b. M/L	DF	Aerial	Rice	6.0	3.0	720[g]	720[g]
2a. M/L	L (AC, FC, Suspension)	Ground boom	Rice	6.0	3.0	200	80
2b. M/L	L (AC, FC, Suspension)	Aerial	Rice	6.0	3.0	720[g]	720[g]
3. A	DF, AC, FC, Suspension	Ground boom	Rice	6.0	3.0	200	80
4. A	DF, AC, FC, Suspension	Aerial	Rice	6.0	3.0	720[g]	720[g]
5. F[h]	DF	Aerial	Rice	6.0	3.0	350[i]	350[i]

a According to product label, mixer/loaders are required to wear coveralls over long-sleeved shirts and long-pants (For DF formulation products, only short-sleeved shirt and short pants are required), chemical-resistant apron, chemical-resistant footwear, chemical-resistant gloves made of any waterproof material; chemical-resistant footwear plus socks; protective eyewear. Applicators wear a long-sleeved shirt and long pants, chemical-resistant headgear for overhead exposure, chemical-resistant gloves made of any waterproof material, shoes and socks.

b M/L: mixer/loader; A: applicator; F: flagger.

c L: liquid; AC: aqueous concentrate; FC: flowable concentrate; DF: dry flowable.

d Maximum use rates are based on product labels.

e Typical use rates are based on the RED (U.S. EPA, 2003 and 2006) and recent five years of pesticide use data (DPR, 2016a).

f Daily Maximum and Typical Treated values were based on the RED (U.S. EPA, 2003 and 2006), and recent five years of pesticide use data (DPR, 2016a). Ground boom mixer/loader/applicator (M/L/A) was assumed to have exposures in the range of M/L and applicators in a day (M/L/A would mix/load part of the day, and apply for the remainder). For this reason, separate M/L/A scenarios were not prepared for these scenarios.

g Based on California regulation (Title 3, California Code of Regulations, Section 6462. Propanil), the maximum treated area by aircraft within each county per day is 720 acres. Therefore, the acres are different from 3,200 acres for maximum and 1,200 acres for typical assumptions in RED (U.S. EPA, 2003 and 2006).

h Most product labels state “Human flagging is prohibited.” However, three DUET 60 product labels do not specify that human flagging is prohibited. To protect all legal handlers, flagger exposures were evaluated in this exposure assessment.

i Acres flaggers handle per day from the Health Effects Division’s (HED's) Science Advisory Council for Exposure, Policy 009.1, Standard Values for Daily Acres Treated in Agriculture. HED, Office of Pesticide Programs (U.S. EPA, 2001).

Table 9. Representative and Represented Post-Application Agricultural Activities with Potential Exposure to Propanil Back

Representative Crop/Site[a]	Representative Reentry Activities[b]	Covered Crops	Covered Reentry Activities[c]
Rice	Scouting	--	Irrigating, Harvesting (Mech)
	Weeding (Hand)	--	Weeding (Mech)

a Based on product labels, propanil is limited to use on rice in California.
b Representative reentry activities are considered to have most exposure.
c Covered reentry activities are considered to be covered by the representative activity and anticipated to have less exposure than that of the representative scenario(s).

Table 10. Summary of Aggregated Exposure Components of Propanil to Agricultural Workers and Residential Bystanders Back

Type	Subpopulation	Duration	POD	Occupational Exposure Scenarios	Drift Exposure Scenarios	Dietary Exposure
Workers	Females of childbearing age (13 to 50 years old)	Short-term Daily (Acute)	Acute: 14.2 mg/kg/day	Herbicide handlers and fieldworkers (O)	NA	Acute Tier 3 food and water (95th percentile exposure) (F)
Residential Bystander: Adult	Females of childbearing age (13 to 50 years old)	Short-term Daily (Acute)	Acute: 14.2 mg/kg/day	N/A	Dermal and inhalation from aerial (fixed and rotary winged aircraft) and ground (ground boom) applications (D and I)	Acute Tier 3 food and water (95th percentile exposure) (F)
Residential Bystander: Child	Children (1 to 2 years old)	Short-term Daily (Acute)	Acute: 14.2 mg/kg/day	N/A	Dermal, inhalation, and oral (cumulative deposition) from aerial (fixed and rotary winged aircraft) and ground (ground boom) applications (D, I, and C)	Acute Tier 3 food and water (95th percentile exposure) (F)

O: combined occupation exposure (i.e., ADD).
F: oral exposure from food and water.
D: dermal exposure from drift.
I: inhalation exposure from drift.
C: cumulative deposition from drift. This includes oral hand-to-mouth, object-to-mouth, and soil ingestion.

Table 11. Estimates of Short-, Intermediate-, and Long-Term Risk (MOEs) from Exposure to Propanil for Herbicide Handlers Back

Job Category[a]	Formulation[b]	Use Rate[c] (lb AI/A or gal)	Acres/ Day[d]	MOE (POD/Acute ADD[e])	MOE (POD/SADD[f])	MOE (POD/AADD[g])
Ground Boom, M/L	DF	Rice=6.0 (max)	200 (max)	5	--	--
Ground Boom, M/L	DF	Rice=3.0 (typical)	80 (typical)	--	24	43
Aerial, M/L	DF	Rice=6.0 (max)	720	1	--	--
Aerial, M/L	DF	Rice=3.0 (typical)	720	--	3	5
Ground Boom, M/L	L (AC, FC, suspension)	Rice=6.0 (max)	200 (max)	2	--	--
Ground Boom, M/L	L (AC, FC, suspension)	Rice=3.0 (typical)	80 (typical)	--	10	18
Aerial, M/L	L (AC, FC, suspension)	Rice=6.0 (max)	720	1	--	--
Aerial, M/L	L (AC, FC, suspension)	Rice=3.0 (typical)	720	--	1	2
Ground Boom, A	DF, AC, FC, suspension	Rice=6.0 (max)	200 (max)	15	--	--
Ground Boom, A	DF, AC, FC, suspension	Rice=3.0 (typical)	80 (typical)	--	74	133
Aerial, A	DF, AC, FC, suspension	Rice=6.0 (max)	720	11	--	--
Aerial, A	DF, AC, FC, suspension	Rice=3.0 (typical)	720	--	22	39
Flagger[h]	DF	Rice=6.0 (max)	350	8	--	--
Flagger[h]	DF	Rice=3.0 (typical)	350	--	16	28

a M/L: mixer/loader; A: applicator; FM: formulation.
b DF: dry flowable; AC: aqueous concentrate; FC: flowable concentrate.
c AI: active ingredient; A: acre.
d Maximum and typical (average) daily acres to be treated in each scenario based on the RED (U.S. EPA, 2003 and 2006). Based on California regulation (Title 3, California Code of Regulations, Section 6462. Propanil), the maximum treated area by aircraft within each county per day is 720 acres.
e Acute Absorbed Daily Dosage (Acute ADD) = (short-term dermal exposure rate [µg/lb. AI handled] x dermal absorption rate + short-term inhalation exposure rate [µg/lb. AI handled] x inhalation absorption rate) x max use rate x max daily treated acres ÷ body weight.
f Seasonal Average Daily Dosage (SADD). SADD = (long-term dermal exposure rate [µg/lb. AI handled] x dermal absorption rate + long-term inhalation exposure rate [µg/lb. AI handled] x inhalation absorption rate) x typical use rate x typical daily treated acres ÷ body weight.
g Annual Average Daily Dosage (AADD) = SADD x annual use months per year/12 months in a year.
h Most product labels include the language: "Human flagging is prohibited." However, three DUET 60 product labels do not prohibit the use of a flagger. To protect all legal handlers, flagger exposure was evaluated in this exposure assessment.

Table 12. Estimates of Short-, Intermediate-, and Long-Term Risk (MOEs) from Exposure to Propanil for Rice Field Workers Back

Task	MOE (POD/Acute ADD)	Ave. DFR[a] (mg/cm^2)	TC[b] ($cm^2/hr.$)	MOE (POD/SADD)	Exposure Months[c]	MOE (POD/AADD)
Scouting	15	7.24	1100	11	2	20
Weeding	233	7.24	70	173	2	311

a Average DFR (dislodgeable foliar residue). According to HHA (Human Health Assessment Branch) practice, the DFR value at the assumed average reentry interval of expiration of the REI (restricted entry interval) plus 7 days. Based on U.S. EPA (2012), if chemical-specific DFR unavailable, 10% per day is used as default residue dissipation to calculate the average DFR of propanil. The DFR on the average REI was estimated based on a log-linear regression model (Edmiston et al., 2002).

b TC (transfer coefficient) values are from the Agricultural Default Transfer Coefficients (U.S. EPA, 2013).

c The annual exposure months for fieldworkers are determined by application periods based on the PUR database (Figure3).

Table 13. Estimates of Short-Term Risk (MOEs) from Drift Exposure to Propanil for Residential Bystanders: Fixed-Wing Aerial Application Method Back

Downwind Distance (ft)	Adult		Child (1-2 years)				
					Oral		
	Dermal	Inhalation	Dermal	Inhalation	Hand-to-mouth	Object-to-mouth	Soil ingestion
0	120	1461	82	502	1989	64091	N/A
25	218	2046	149	863	3634	117500	N/A
50	297	2461	203	1034	4947	156667	N/A
100	513	3205	350	1373	8545	282000	N/A
250	945	3341	645	1461	15667	470000	N/A
500	1430	4700	976	2003	23898	705000	N/A
1000	2587	9658	1767	4040	42727	1410000	N/A

Table 14. Estimates of Short-Term Risk (MOEs) from Drift Exposure to Propanil for Residential Bystanders: Rotary Winged Aerial Application Method Back

Downwind Distance (ft)	Adult		Child (1-2 years)				
					Oral		
	Dermal	Inhalation	Dermal	Inhalation	Hand-to-mouth	Object-to-mouth	Soil ingestion
0	72	1040	49	340	1192	39167	N/A
25	238	2086	163	790	3972	128182	N/A
50	412	2787	281	1105	6845	235000	N/A
100	793	3821	541	1579	13178	470000	N/A
250	1875	5802	1278	2414	31333	1410000	N/A
500	3019	9400	2061	3917	50357	1410000	N/A
1000	6052	20143	4123	8393	100714	NA	N/A

Table 15. Estimates of Short-Term Risk (MOEs) from Drift Exposure to Propanil for Residential Bystanders: Ground Boom Application Method Back

Downwind Distance (ft)	Adult		Child (1-2 years)				
					Oral		
	Dermal	Inhalation	Dermal	Inhalation	Hand-to-mouth	Object-to-mouth	Soil ingestion
25	572	2046	390	863	19054	705000	N/A
50	863	2461	589	1034	28776	1410000	N/A
75	1157	2781	789	1180	38108	1410000	N/A
100	1469	3205	1002	1373	48621	1410000	N/A
150	2014	3249	1373	1402	67143	1410000	N/A
200	2587	3294	1767	1430	88125	1410000	N/A
250	3197	3341	2183	1461	108462	N/A	N/A
300	3884	3543	2650	1544	128182	N/A	N/A

Table 16. Estimates of Short-Term, Aggregate Risk (MOEs) from Exposures to Propanil for Workers Back

Job Category or Task	Formulation, Use Rate, and Acres per Day	Exposure	MOE
Ground boom, M/L	DF, Rice = 6.0 (max), 200 (max)	O	5
		O + F	5
Aerial, M/L	DF, Rice = 6.0 (max), 720	O	1
		O + F	1
Ground boom, M/L	L (AC, FC, suspension), Rice = 6.0 (max), 200 (max)	O	2
		O + F	2
Aerial, M/L	L (AC, FC, suspension), Rice = 6.0 (max), 720	O	1
		O + F	1
Ground boom, A	DF, AC, FC, suspension, Rice = 6.0 (max), 200 (max)	O	15
		O + F	15
Aerial, A	DF, AC, FC, suspension, Rice = 6.0 (max), 720	O	11
		O + F	11
Flagger	DF, Rice = 6.0 (max), 350	O	8
		O + F	8
Scouting	N/A	O	15
		O + F	15
Weeding	N/A	O	233
		O + F	231

M/L: mixer/loader; A: applicator.
DF: dry flowable; L: liquid; AC: aqueous concentrate; FC: flowable concentrate.
O: combined occupation exposure (i.e., ADD).
F: oral exposure from food and water.

Table 17. Estimates of Short-Term, Aggregate Risk (MOEs) from Exposures to Propanil in Residential Bystanders in Aerial Application Scenarios: Females of Childbearing Age (13 to 50 years old) Back

Drift Scenario	Exposure Route	Downwind Distance (ft)						
		0	25	50	100	250	500	1000
Fixed Wing Aerial Application	D	120	218	297	513	945	1430	2587
	D + I	111	197	265	442	737	1096	2041
	D + I + F	110	196	263	436	721	1061	1922
Rotary Winged Aerial Application	D	72	238	412	793	1875	3019	6052
	D + I	67	214	359	657	1417	2285	4653
	D + I + F	67	213	355	644	1359	2138	4080

D: dermal exposure from drift.
I: inhalation exposure from drift.
F: oral exposure from food and water.

Table 18. Estimates of Short-Term, Aggregate Risk (MOEs) from Exposures to Propanil in Residential Bystanders in Ground Boom Application Scenarios: Females of Childbearing Age (13 to 50 years old) Back

Drift Scenario	Exposure Route	Downwind Distance (ft)							
		25	50	75	100	150	200	250	300
Ground Boom	D	572	863	1157	1469	2014	2587	3197	3884
	D + I	447	639	817	1007	1243	1449	1634	1853
	D + I + F	441	627	797	977	1198	1388	1557	1755

D: dermal exposure from drift.
I: inhalation exposure from drift.
F: oral exposure from food and water.

Table 19. Estimates of Short-Term, Aggregate Risk (MOEs) from Exposures to Propanil in Residential Bystanders in Aerial Application Scenarios: Children (1 to 2 years old) Back

Drift Scenario	Exposure Route	Downwind Distance (ft)						
		0	25	50	100	250	500	1000
Fixed Wing Aerial Application	D	82	149	203	350	645	976	1767
	D + I	70	127	169	279	447	656	1229
	D + I + C	68	123	164	270	435	638	1194
	D + I + C + F	67	121	161	264	419	605	1084
Rotary Winged Aerial Application	D	49	163	281	541	1278	2061	4123
	D + I	43	135	224	403	836	1351	2765
	D + I + C	41	130	217	391	814	1314	NA
	D + I + C + F	41	129	213	378	761	1183	NA

D: dermal exposure from drift.
I: inhalation exposure from drift.
C: cumulative deposition from drift. This includes oral hand-to-mouth, object-to-mouth, and soil ingestion.
F: oral exposure from food and water.

Table 20. Estimates of Short-Term, Aggregate Risk (MOEs) from Exposures to Propanil in Residential Bystanders in Ground Boom Application Scenarios: Children (1 to 2 years old) Back

Drift Scenario	Exposure Route	Downwind Distance (ft)							
		25	50	75	100	150	200	250	300
Ground Boom	D	390	589	789	1002	1373	1767	2183	2650
	D + I	269	375	473	579	694	790	875	976
	D + I + C	265	370	467	572	686	783	NA	NA
	D + I + C + F	259	359	449	546	649	734	NA	NA

D: dermal exposure from drift.
C: cumulative deposition from drift. This includes oral hand-to-mouth, object-to-mouth, and soil ingestion.
F: oral exposure from food and water.

Table 21. MOEs for Acute Dietary Exposure Back

Population Subgroup	95th Percentile	99th Percentile	99.9th Percentile
Total US Population	25677	12981	5953
Hispanic	19624	11035	5719
Non-Hispanic White	31908	16964	7766
Non-Hispanic Black	24944	12721	6591
Non-Hispanic Other	11498	7106	4130
Nursing Infants	10477	6254	2558
Non-Nursing Infants	8040	4351	1922
All Infants	9044	4709	2150
Females 13-50 years old	33092	17830	9821
Children 1-2 years old	11822	5864	2965
Children 3-5 years old	13041	7686	5191
Children 6-12 years old	20864	12151	6271
Adults 50-99 years old	39339	21140	10520

Table 22. MOEs for Chronic Dietary Exposure Assessment Back

Population Subgroup	Chronic MOE	% of POD
Total US Population	9527	0.01%
Hispanic	7009	0.01%
Non-Hispanic White	11420	0.01%
Non-Hispanic Black	9243	0.01%
Non-Hispanic Other	4302	0.02%
Nursing Infants	6521	0.02%
Non-Nursing Infants	3446	0.03%
All Infants	4034	0.02%
Females 13-50 years old	12706	0.01%
Children 1-2 years old	3889	0.03%
Children 3-5 years old	4682	0.02%
Children 6-12 years old	7492	0.01%
Adults 50-99 years old	13945	0.01%