HUMAN PESTICIDE EXPOSURE ASSESSMENT

PROPARGITE

(A Miticide for the Control of Spider Mites on a Variety of Agricultural Commodities)

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Worker Health and Safety Branch
Cal/EPA Department of Pesticide Regulation

HS-1527 November 30, 1989
Revision No. 1 December 20, 2013

ABSTRACT

Propargite (CAS name: 2-[4-(1,1-dimethylethyl)phenoxy]cyclohexyl 2-propynyl sulfite) is a contact active, non-systemic organosulfite miticide with long residual activity. No uses are registered for residential, recreational, or other public settings. The commodities on which propargite may be used as the active ingredient (AI) in California include almonds, cotton, corn, field-grown roses, walnuts, oranges, grapes, nectarines, dry beans, non-bearing fruit and nut trees, and many more. As of December 2013, three end-use propargite products are actively registered in California. Of the propargite AI used in California between 2007 and 2011, collectively over 90% was used on alfalfa, almonds, corn, cotton, dry beans, grapes, and walnuts. From 1982 through 2010, a total of 1,057 illness cases reportedly occurring in California were associated with exposure to propargite used alone, or used in combination with other pesticides. Of these 1,057 cases, 66% involved skin irritation as the only reported symptom. From the long incidents history dating back to the mid-1970s, current illness data continue to show considerable link between reported incidents and propargite use (until in more recent years). In an effort to reassess the regulatory actions taken thus far for the containment of these illness incidents, the Worker Health and Safety Branch now has revised its exposure assessment for propargite that was performed over two decades ago. At that time, propargite was shown to produce moderate to severe dermal irritation in the rabbit and dermatitis in humans. Currently, it is additionally listed under California's Safe Drinking Water and Toxic Enforcement Act of 1986 as a chemical known to the State to cause cancer and reproductive toxicity. This exposure assessment revision is also written as an integral part of the risk characterization document prepared by the Department for all propargite uses. The 8-hour acute absorbed daily dosage (ADD) calculated for aerial applicators handling the wettable powder in water soluble bags was 5,300 μg/day per kilogram (kg) of body weight (BW); this was the highest calculated among the agricultural handlers. The highest 8-hour acute ADD estimated for fieldworkers was 340 μg/kg BW/day; this was for field-grown rose cutters. The highest 24-hour acute ADD estimated for toddler bystanders was 1.4 μg/kg BW/day. The results of several rat studies supported the conclusion that dermal absorption of propargite in humans is likely less than 17% over a 10- to 24-hour exposure period. A review of the available metabolism studies indicated that approximately 73% of the dose given orally to rats was excreted in feces (48%) and urine (25%) by 96 hours after dosing.

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ABBREVIATIONS AND ACRONYMS

AADD	annual average daily dosage
ADD	absorbed daily dosage
AI	active ingredient
ARB	California Air Resources Board
BW	body weight
CAS	Chemical Abstracts Service
CCR	California Code of Regulations
CFAC	California Food and Agriculture Code
CFR	Code of Federal Regulations
CR	control(led) release (*product label language*)
CV	coefficient of variation
Det	detected
DFR	dislodgeable foliar residue
DPR	California Department of Pesticide Regulation
EC	emulsifiable concentrate
EQL	estimated quantitation limit
FC	field crops
FN	fruits and nuts
GM	geometric mean
LADD	lifetime average daily dosage
Ma (Ms)	multiplier for *a*cute (*s*ubchronic) exposure
MDL	minimum detection limit
MedTox	Medical Toxicology Branch at DPR
M/L/A (M/L/Applicator)	mixer/loader/applicator
PHED	Pesticide Handler Exposure Database
PHI	preharvest interval
PISP	Pesticide Illness Surveillance Program
PK	pharmacokinetics
PPE	personal protective equipment
PUR	Pesticide Use Report
OT	ornamentals, trees, and nursery/greenhouse
RCD	risk characterization document (DPR's)
RED	Reregistration Eligibility Decision (U.S. EPA's)
REI	restricted entry interval
SADD	seasonal average daily dosage
SLN	special local need (California's product label language)
TR (TC)	(dermal) transfer rate (transfer coefficient)
UCL	upper confidence limit
U.S. EPA	U.S. Environmental Protection Agency
Veg	vegetables
WHS	Worker Health and Safety Branch at DPR
WP	wettable powder
WSB	water-soluble bag

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I. INTRODUCTION

Propargite is a miticide as well as an acaricide used in California to control several species of spider mites on a wide variety of agricultural crops. No propargite uses are registered for residential, recreational, or other public settings in the United States. The commodities on which propargite may be used as the active ingredient (AI) in California include almonds, cotton, corn, field-grown roses, walnuts, oranges, grapes, nectarines, dry beans, non-bearing fruit and nut trees, and many more. This AI is an organosulfite with the ability to destroy larval and adult mites through certain toxicological actions that have yet to be established. Propargite was introduced as an acaricide by Uniroyal Chemical (Tomlin, 1994), and now marketed under the trade name Comite® or Omite® by Chemtura Corporation.

The string of illness incidents linked to propargite use has a long history for agricultural workers in California. Due partly to these illness incidents dating back to the mid-1970s, an exposure assessment (Thongsinthusak *et al*., 1989) was performed a little more than two decades ago by the Worker Health and Safety Branch (WHS) of this Department, California Department of Pesticide Regulation (DPR), for workers exposed to propargite in California. At that time, propargite was shown to produce moderate to severe dermal irritation in the rabbit and dermatitis in humans. Currently, the organosulfite is additionally listed under California's Safe Drinking Water and Toxic Enforcement Act of 1986 as a chemical known to the State to cause cancer (since October 1, 1994) and reproductive toxicity (since June 15, 1999).

Inasmuch as the current illness data continue to show considerable association between reported incidents and use of propargite (until in more recent years), there have been concerns with the regulatory actions or mitigation measures that are in effect. U.S. EPA (2001a) revised the occupational exposure assessment chapter (Tadayon, 2000) of its Reregistration Eligibility Decision (RED) for propargite partly in an effort to reassess the efficacy of these regulatory actions. DPR is now following suit to prepare the risk characterization document (RCD) for all propargite uses in California. Accordingly, this exposure assessment revision is written not only as a stand-alone document but also as an integral part of the RCD. The main difference between this and the outdated version (i.e., Thongsinthusak *et al*., 1989) is in this revision's use of more current information and assumptions, including most current (actively registered) product labels and the latest exposure-related data, for calculating the worker and residential exposures involved.

As in all cases, the Department's RCD is being prepared in accordance with *California Food and Agricultural Code* (*CFAC)* Sections 11501, 12824-12826, 13121-13135, 14102, and 14103, which collectively and specifically require that DPR must protect individuals and the environment from potential adverse effects that may result from pesticide use in California. As part of the Department's effort to meet this mandate, but due to its limited resources, pesticide AI are necessarily prioritized for assessment of exposure and risk potential. A fuller description of the pesticide risk prioritization process can be found on the DPR webpage (http://www.cdpr.ca.gov/docs/risk/raprocess.pdf). After risk (and exposure) prioritization, pesticide AI are evaluated in accordance with Title 3, *California Code of Regulations (CCR)*, Section 6158. For propargite, the risk prioritization was based largely on human dermatitis, cancer, reproductive toxicity, and (other) adverse health effects found in laboratory animals.

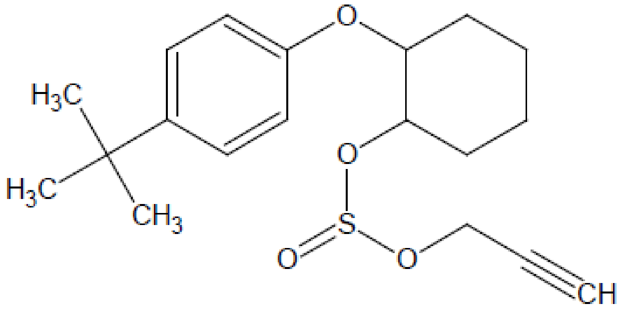
II. EXPOSURE-RELATED FACTORS

1. Physical and Chemical Properties

All properties listed below are as reported in the previous version (Thongsinthusak *et al*., 1989) of the exposure assessment for propargite, in U.S. EPA's exposure assessment chapter (Tadayon, 2000) for its RED for propargite, or in *The Pesticide Manual* edited by Tomlin (1994). In addition to boiling (~200^{o}C), propargite can be decomposed easily and quickly by strong acids and alkalis, and is slowly degraded by heat but not light. This organosulfite is practically insoluble in water (632 mg/L at 25^{o}C), but is miscible with many organic solvents (e.g., acetone, benzene, ethanol, methanol).

Molecular formula:	$C_{19}H_{26}O_4S$
Molecular weight:	350.5
Technical grade:	a light to dark brown viscous liquid
Vapor pressure:	0.006 mPa (4.5 x 10^{-8} mm Hg) at 25^{o}C
Specific gravity:	1.113 at 20^{o}C
Octanol/water partition coefficient (log K_{ow}):	3.66 at 25^{o}C

Chemical structure:



2. Formulations and Label Uses

As of December 2013, there are three propargite products actively registered in California. These three products are manufactured by Chemtura Corporation, which in 2005 acquired Crompton Corporation that earlier in 1996 acquired Uniroyal Chemical (the company that introduced propargite as an acaricide). Collectively, the three products are available in two basic formulations: emulsifiable concentrate (EC) and wettable powder (WP), with the latter being packaged in water soluble bags (WSB). An overview is given in Table 1 outlining the major specifics of these three products. For the purpose of the present exposure assessment, the three products were subsumed under two formulation/packaging categories (i.e., EC and WSB) in order to account for the different sets of clothing and personal protective equipment (PPE) imposed on the handlers (*see* subsection on Label Precautions below).

Table 1. Propargite Products Actively Registered in California as of December 2013

Product Name[a]	*Manufacturer*	*EPA Reg. No.*	*Formulation*[b]	*% AI*[c]
Omite-6E	Chemtura	400-89-ZA	EC	69.2
Comite	Chemtura	400-104-ZB	EC	73.6
Omite-30WS	Chemtura	400-427-ZA	WP (WSB)[d]	32.0

[a] all products are for agricultural use only.

[b] WP = wettable powder; EC = emulsifiable concentrate; WSB = water soluble bag.

[c] by weight.

[d] each pack of the WP product containing two WSBs with each weighing 2½ lb.

As of December 2013, propargite products are registered in California for use on corn (field and sweet), almonds, walnuts, cotton, grapes, beans, nectarines, Christmas tree/conifer (for plantation), jojobas, field-grown roses, and many more. They may also be used on many non-bearing tree or nut crops (e.g., apples, peaches), non-bearing strawberries, and oranges as well as cherries that have been harvested. The five special local need (SLN) registrations still in effect as of this date (December 2013) have extended certain uses or application methods for cotton (CA-820083), field-grown roses (CA-940008), non-bearing almonds and walnuts (CA-940031), alfalfa seed (CA-8300024), and clover seed (CA-040013).

Label rates for crops in the three products vary from 0.55 to 4.8 lb AI per acre (A). The labels allow 1 to 2 applications per year for most crops, with a maximum of 3 applications (e.g., for cotton, non-bearing apples, and non-bearing strawberries). However, the SLN CA-940008 label allows unlimited aerial applications to field-grown roses, with a restricted entry interval (REI) of 7 days (*see* the Exposure Appraisal section for further discussion on this SLN use).

3. Label Precautions

The three propargite products actively registered in California are all classified as having Category I toxicity (with the signal word DANGER), mainly because the chemical is highly corrosive and irritating to the skin and the eyes. The hazards from ingestion, inhalation, and dermal contact are indicated on all labels. None of the labels contains a statement concerning skin sensitization. Nonetheless, it has been DPR's practice that skin sensitization studies are not required if a chemical causes skin corrosion or irritation with Category I severity. This is because with such severe irritation properties, it is extremely difficult to obtain experimental evidence for the dermal sensitization potential of a chemical in its concentrate form.

All three product labels for propargite require handlers to wear protective eyewear and normal work clothes (i.e., long pants, a long-sleeved shirt, and shoes plus socks). For handling the EC products, workers are additionally required to wear coveralls over normal work clothes, chemical-resistant gloves, chemical-resistant headgear (for head exposure), and when mixing, loading, or cleaning (the equipment), also a chemical-resistant apron.

The REIs vary greatly from 7 days (e.g., cotton scouting) to 30 days (e.g., grape harvesting). In particular and as stated earlier, the SLN for cutting/harvesting field-grown roses treated via aerial equipment specifically requires an REI of 7 days. In California, hand labor that involves contact with treated surfaces is not allowed during the REI (3 *CCR* Section 6770).

4. California Requirements

Title 3 *CCR* Section 6746 requires that an approved closed system be used when mixing and loading pesticides having Category I toxicity, as long as the usage per application exceeds 1 gallon. This additional requirement thus applies to mixing and loading propargite products in much of the daily operations, since these daily operations each easily cover more than a few acres and since the minimum label rate for all propargite products is typically well over 0.55 lb AI per acre. Section 6738 (in this same Title 3 of *CCR*) also requires that handlers wear chemical-resistant gloves when using handheld equipment or during mixing/loading. In addition, Section 6772 provides a different set of REIs for California workers entering fields treated with propargite, with 21 days for many crops (*see* Table I-C in Appendix I). There are no other worker safety requirements specifically for California fieldworkers or handlers working with propargite that will have an impact on the exposure assessment.

5. Usage in California

According to the available Pesticide Use Reports (PUR) from DPR (2013), collectively over 90% of the total five-year usage of propargite in California from 2007 through 2011 was used on alfalfa, almonds, corn, cotton, dry beans, grapes, and walnuts. Table 2 ranks the crops or sites on which propargite was applied during 2007 through 2011. The ranking was based on the total amount of the AI applied at each site during the five-year period. Since all propargite products currently registered in California are for agricultural uses only, there should be no use in the residential, recreational, or other public settings. Review of the sales (i.e., mill assessment) data thus would not reveal any unreported crops/sites for this AI.

6. Reported Illnesses in California

The string of incidents associated with use of propargite has a long history for agricultural workers in California. It has been reported by O'Malley *et al.* (1987) that between 1974 and 1983, about 400 cases of dermatitis were linked to propargite used in California. Again, as noted earlier, it was due in part to these illness incidents that an exposure assessment for California workers handling propargite was performed by WHS (Thongsinthusak *et al.*, 1989) a little more than two decades ago.

Table 2. Ranking for All Reported Uses of Propargite, 2007-2011

Commodity/Site	*Pounds AI Applied* [a]	*Percentage*
Corn (forage - fodder)	846,922	44.4
Almond	371,103	19.5
Walnut (English walnut, Persian walnut)	285,330	15.0
Corn, human consumption	80,152	4.2
Grapes, wine	48,390	2.5
Alfalfa (forage –fodder, alfalfa hay)	42,842	2.2
Beans, dried-type	41,501	2.2
Cherry	38,805	2.0
Grapes	32,119	1.7
Cotton, general	31,349	1.6
Corn, field	20,134	1.1
Nectarines	17,622	0.9
Mint (all or unspecific)	15,225	0.8
Beans, succulent (other than lima)	13,911	0.7
Bean (all or unspecific)	7,736	0.4
Nursery-outdoor container/field grown plants	4,396	0.2
(Others)	(*7,975*)	*(0.4)*
Total (all commodities/sites in the 5-year period)	1,905,513	*100.0*

[a] usage of propargite active ingredient (AI) is for the total 5 years based on the Pesticide Use Reports data provided by the Department of Pesticide Regulation (DPR, 2013).

The Pesticide Illness Surveillance Program (PISP) database maintained in WHS indicates that from the first available year 1982 through the latest available year 2010 (as of December 2013), a total of 1,057 illness/injury cases occurring in California were determined as associated with exposure to propargite used alone, or used in combination with other pesticides (Mehler, 2005, 2009, 2010; Holland, 2013). Table 3 lists the 1,057 cases by activity and illness type. The table shows that 66% of the cases (i.e., 702 cases) involved skin irritation alone. A total of 19 cases occurred in a non-occupational setting, associated primarily with exposure to drift. Of these 19 cases, 84% (16 cases) were associated with propargite used in combination with other pesticides. The overall 1,057 cases resulted in a total of 13 days of hospitalization and 55 days lost from work, with all of the former and most of the latter days occurring prior to 1991. Note that the illness/injury data recorded prior to 1992 were classified somewhat differently according to an outdated protocol. They were nonetheless included here to avoid any data gap between cases first reported in the 1970s by O’Malley *et al*. (1987) and those reported in recent years.

Records maintained by PISP also reveal that since the year 1982, 16 priority investigations of pesticide outbreaks have been conducted in which worker exposure to propargite was identified as the possible cause (Mehler, 2001, 2005, 2009, 2010; Holland, 2013). The most notable outbreak occurred in 1986, when the then still actively-registered CR (*c*ontrolled *r*elease) formulation (i.e., that strictly for use in California on oranges, grapefruit, and lemons) affected more than 100 fieldworkers. Its use was thereby promptly suspended until its reentry intervals were later extended in 1988. (That CR product nonetheless has not been actively registered in California since 2009). Apparently, the illness incidents associated with propargite applications have been reduced since 1986, except for a 1995 episode of 65 cases when a Fresno County grower made two applications in close succession. The last outbreak occurred in 1999, with 7 cases also from Fresno County (Mehler, 2010).

Table 3. Number of Illnesses and Injuries Associated with Exposure to Propargite Alone or in Combination with Other Pesticides Used in California, 1982-2010

Activity	*Illness/Injury Type*[a]				
	Systemic	*Eye*	*Skin*	*Eye/Skin*	*Total*
Attributed to propargite alone[b]					
Occupational[c]	62	94	537	23	716
Non-occupational	1	1	1	0	3
Attributed to propargite in combination with other pesticide(s)[b]					
Occupational[c]	121	25	164	12	322
Non-occupational	16	0	0	0	16
Total	200	120	702	35	1,057

[a] cases are characterized as relating to the eye, to the skin, and/or as being systemic; designation as *systemic* characterizes cases that exhibited any signs or symptoms other than, or in addition to, those limited to eyes and/or skin.

[b] attribution is determined to be definitely, probably, or possibly associated with propargite use; an association of *definite* indicates that both physical and medical evidences document exposure and consequent health effects; *probable* association indicates that limited or circumstantial evidence supports a relationship to pesticide exposure; *possible* association indicates that evidence neither supports nor contradicts a relationship.

[c] all exposures that occurred while the affected person was at work are considered occupational.

In the 1995 episode, 65 of 250 workers complained of symptoms when they began turning cane in a vineyard during the second week of August. The vineyard had been treated with propargite at the rate of 6.25 lb product/acre on June 29 and July 7. Of the 65 cases, 64 had skin symptoms. The 1999 episode also took place in a vineyard, which was treated with propargite (at the rate of 7 lb product/acre) more than a month before the reentry activity took place. This application, however, was complicated by a mistaken delivery and use of *lambda*-cyhalothrin. The applicators accepted this delivery, added it to the propargite tank mix, and applied this inappropriate mixture to the vineyard. The pyrethroid cyhalothrin was not registered for use on grapes, and none of its registrations allowed use at nearly so high a rate as was applied to the grapes. Of the 11 workers who entered the vineyard, 7 reported symptoms with all having problems with the eyes, skin, and respiratory system (i.e. typical pyrethroid symptoms). Samples confirmed presence of propargite at greater than expected levels and cyhalothrin at extraordinarily high levels (*see* Spencer, 2000).

7. Potential Exposure Scenarios by Worker Categories

The potential exposure scenarios for propargite considered in *this* exposure assessment (*revision*) were all derived from the two comprehensive lists included in the scoping proposal performed recently, and attached to this revision document as Appendix I. The two lists (i.e., Table I-A for agricultural handlers and Table I-B for agricultural fieldworkers) were based on all current California label uses. From these two lists, nine (9) worker *categories* of potential exposure scenarios were identified and used for the purpose of facilitating the assessment presentation and discussion. These worker categories were similar to those used by U.S. EPA (2001a) for its RED for propargite, as well as to those outlined in the initial scoping proposal (Thongsinthusak, 1998) conducted for an earlier attempt to revise the exposure assessment. The nine propargite worker categories were: (1) mixing/loading for aerial application; (2) mixing/loading for airblast; (3) mixing/loading for groundboom spray; (4) application by aerial equipment; (5) application by airblast equipment; (6) application by groundboom equipment; (7) flagging for aerial spray; (8) mixing/loading and application by handheld equipment; and (9) reentry of fieldworkers.

As discussed in Section V-2 and Appendix I, a total of 19 *sub*-scenarios (or commonly referred to as *representative* scenarios) were further identified for use to cover all the critical activities related to reentry exposure in fields treated with propargite. Note that in the present assessment, inhalation exposures were specifically assessed for bystanders and residents located close to or away from fields (being) treated with propargite. Otherwise, exposures to propargite in residential and other non-agricultural settings were not specifically considered here, in that propargite is not registered for such uses (*see* further discussion in Section VI-7).

III. ACUTE TOXICITY AND PHARMACOKINETICS

1. Acute Toxicity and Dermal Sensitization

The *acute* toxicity of propargite is considered low in general, despite the fact that the AI is now listed in California as a chemical known to cause reproductive toxicity (and cancer). As summarized in U.S. EPA's revised toxicology chapter (Shallal, 2000) for the RED, the acute toxicity of propargite technical is low via the oral route, with an oral LD_{50} of 2,800 mg/kg observed in male and female rats (Toxicity Category III). The acute toxicity from inhalation is also low, with a high LC_{50} of 0.89 mg/L in male and female rats exposed for four (4) hours (Toxicity Category III). The acute LD_{50} for dermal is likewise high, at >2,000 mg/kg in the rabbit (Toxicity Category III). Propargite is corrosive to the skin and the eyes of rabbits (Toxicity Category I). As pointed out earlier, due to such severe irritation properties, it is extremely difficult to obtain experimental evidence for the dermal sensitization potential of propargite in its concentrate (i.e., technical) form.

2. Dermal and Inhalation Absorption

U.S. EPA (Tadayon, 2000) used 14% of the applied dose for daily dermal absorption and the default 100% (for lack of data) for daily inhalation absorption in calculating the absorbed doses of propargite. Their conclusion on dermal absorption was based on two studies with rats (Chadwick, 1989a, 1989b). At WHS, a daily dermal absorption of 17% was used in the previous version (Thongsinthusak *et al*., 1989) of the exposure assessment for this AI. The rationale for using the higher dermal absorption by WHS was documented in its two reviews. The first (Thongsinthusak, 1989) of the two WHS reviews was on a draft study report submitted by the registrant presenting preliminary results on all formulations available at the time less the technical (i.e., on only Comite, Omite-6E, and Omite-30W). The second WHS review (Thongsinthusak, 1990) was on a more comprehensive study report (Banijamali, 1990) covering all formulations (i.e., including Omite Technical). In each of the earlier set of studies (i.e., those included in the first WHS review), a C^{14}-based dose of 0.05, 0.5, or 5.0 mg/kg was applied to approximately 10 cm^2 of the rat's shaved skin. For the dermal absorption in rats exposed to 0.05 mg/kg for 24 hours, the upper end of the range was calculated by the WHS reviewer as 17%. The reviewer recommended using this upper-end value in the human exposure assessment in part because he considered this test dose to be relatively more comparable to actual worker exposure to propargite.

In subsequent studies on all formulations (as covered in the second WHS review), the same three C^{14}-based dose levels (0.05, 0.5, and 5.0 mg/kg) were applied to the back and shoulder of male rats. These subsequent studies were considered well executed as evident from the good to excellent recoveries (80 to 99% of the applied) observed for all test doses. As determined by the same WHS reviewer (Thongsinthusak, 1990), dermal absorption rates averaged from 10 to 19% for the lowest dose groups that were exposed to non-technical formulations for 24 hours. Based on the general observation that many pharmacokinetics (PK) studies by nature have inherent variability, the WHS reviewer reinstated his support for using 17% as the absorption rate for estimation of the absorbed doses of propargite for California workers. Since that time, no further data on dermal absorption of propargite have been submitted for evaluation.

The absorption values considered in the two WHS reviews all included a high percent of *bound skin residues* (up to 34% for the WP formulation), and were adjusted for radioactivity recovery (on the basis of a 99% C^{14} purity used). In all cases, analysis of radioactivity was accomplished via a liquid scintillation counter, in samples including urine, feces, carcasses, cage washes, blood, exposed skin, unabsorbed dose, and skin cover. The rats were killed after anesthesia at the end of each exposure period (0, 2, 4, 8, or 24 hours). As specified in the study protocol, which was reviewed by WHS beforehand, four male rats (200-249 grams) were used for each exposure period in each dose group per each test.

The present exposure assessment continued to employ the daily rate of 17% for calculating dermal absorption of propargite in workers largely due to the following reasons. The tests and calculations as described in the two WHS reviews were consistent with the current practice at WHS. The two upper-end values (17% and 19%) determined by the same WHS reviewer were comparable to the 14% used in the RED, while each conservatively including a high percent of bound skin residues. They were just off by 2%, which is readily attributable to the variability inherent in this type of data (a point also commented by the WHS reviewer).

This exposure assessment used the interim default (Frank, 2008) of 100% for inhalation absorption since no such data specifically for propargite were made available to WHS.

3. Animal and Human Metabolism

Human Studies. No metabolism studies were available for evaluating the biotransformation of propargite specifically in humans. As with dermal absorption, animal studies were hence used as surrogates to investigate the metabolic fate and the PK of propargite in humans.

Animal Studies. Several laboratory studies (Banijamali, 1989; Banijamali and Nag, 1990, 1991; Chadwick, 1989a, 1989b; Doweyko and Tortora, 1989) were evaluated by U.S. EPA (Shallal, 2000) for the metabolism (including absorption) of propargite in animals. Variant editions (Banijamali, 1989) of the earlier studies were also evaluated and used by WHS in its previous version (Thongsinthusak *et al*., 1989) of the exposure assessment for propargite. As highlighted in the U.S. EPA review (Shallal, 2000), the most striking observation from these studies perhaps was the one that, following oral dosing, mice absorbed propargite about 5 to 7 times more rapidly than rats did.

A three-part series was also summarized and submitted (Gay, 1994), which had a particular focus on the PK of propargite. The first part (Sabourin *et al*., 1994) was conducted to compare the chemical disposition and distribution of C^{14}-Omite in both sexes of rats and mice following an oral or intravenous administration. This first part showed that mice eliminated propargite about two times faster than rats did. The second part (Andre and Laveglia, 1994) was conducted to estimate the PK parameters of biliary elimination from rats and mice following a single oral dose of C^{14}-Omite. In this second part, total percentages of the applied radioactivity eliminated were similar in the biles of rats and mice. The third part (Banijamali *et al*., 1994) of the PK series was conducted to characterize and compare the metabolites observed in the bile and plasma of male and female rats and mice. This third part showed that, in general, profiles of both biliary and plasma metabolites qualitatively resembled each other in the male and female rats and mice tested. No metabolites were found unique only to rats or to mice.

Overall, approximately 73% of the dose given orally to rats was excreted in feces (48%) and urine (25%) by 96 hours (4 days) after dosing, with 2.6% in the carcass (Shallal, 2000; Gay, 1994). With mice, 69% was excreted in urine (40%) and feces (29%) by 96 hours, with 2.1% in the carcass. A PK study (Doweyko and Tortora, 1989) was also conducted to compare the metabolism of propargite in adult female rats, rabbits, and monkeys all given an oral dose of C^{14}-Omite. Preliminary data from that study showed that by 24 hours, the rabbit exhibited the largest percent unabsorbed (60%), compared to the rat (44%) and the monkey (34%). Several metabolites were identified in the urine and feces of the mice and rats (Banijamali and Nag, 1991; Shallal, 2000). Three of these metabolites were found chemically polar (i.e., water-soluble). One metabolite was found in the urine of female, but not male, rats.

IV. ENVIRONMENTAL CONCENTRATIONS

1. Ambient and Offsite Air Concentrations

In the summer of 1996, the California Air Resources Board (ARB, 1998) conducted a field study in which the application (i.e., offsite) and ambient air concentrations were monitored for propargite used in Fresno County. Offsite air monitoring was conducted in the area where propargite was ground sprayed to a 20-acre grape vineyard. Ambient air monitoring was also conducted to coincide with the peak use of propargite on grapes. Of the 100 ambient samples collected (excluding spikes and blanks), none was found above the limit of quantification (0.28 $\mu g/m^3$). The highest air concentration found around the offsite area was 0.44 $\mu g/m^3$, that observed at the east sampling site of the field during the 25th hour post-application. The study reportedly had encountered some analytical problems, which were not disclosed in any detail in its report.

In the summer of 1999, ARB (2000) thereby repeated the study in which ambient air levels of propargite were monitored to coincide with its peak use on cotton and grapes in Fresno County. Also monitored were the offsite air concentrations of propargite for the area where in July the pesticide was sprayed to 12 acres of grapes using ground spray rigs. In that study, both the ambient and offsite air levels were also monitored for the pyrethroid pesticide bifenthrin, as in those years the peak use areas and periods for both pesticides were very similar.

Of the 176 ambient air samples collected (excluding spikes and blanks) in the 1999 study, none indicated a 24-hour air concentration of propargite greater than 1.3 $\mu g/m^3$. The site at which this highest 24-hour ambient level was observed also yielded the highest average ambient concentration of 0.17 $\mu g/m^3$ for the six-week monitoring period. The highest propargite air concentration found from the offsite air monitoring was 3.5 $\mu g/m^3$, which was observed at the south sampling site during the first 1.5 hours post-application.

Given that the application rates used for the offsite air monitoring were comparable in the two ARB field studies, the 8-fold (i.e., 3.5 *vs*. 0.44 $\mu g/m^3$) difference observed in the offsite air concentrations was likely attributed to the analytical problems encountered in the 1996 earlier study, along with such variables as the applications being made under different field and/or meteorological conditions. These same variables could also cause similar effects leading to the different ambient air concentrations (1.3 *vs*. 0.28 $\mu g/m^3$) observed in the two studies. A summary table is given in Section V-3 for the presumably more reliable 1999 air monitoring data used in the present exposure assessment.

2. Dislodgeable Foliar Residues

As further explained in Section V-2 and with additional elaboration given in Appendix II, of all types of environmental concentrations of pesticide residues, dislodgeable foliar residues (DFR) are perhaps those most relevant to reentry field exposure received in any agricultural setting. As by virtue of their job functions, many groups of fieldworkers (e.g., harvesters, pruners, leaf thinners, scouts, cane turners) are inevitably subject to exposure from dermal contact with dislodgeable residues on foliage treated with propargite. The amount of DFR available on treated foliage is primarily a function of their dissipation behavior and the application rate used (though usually within a practical range). In addition, foliar dissipation is usually specific to a cluster of crops, as all DFR in that cluster are presumably affected by similar meteorological conditions and other similar external factors (e.g., biological makeup and fullness of foliage). It was with this notion that the registrant was usually requested to provide U.S. EPA as well as DPR with the required DFR data by crop group. These DFR studies were used extensively in estimating the reentry exposures in the present assessment, as summarized in Section V-2.

The dissipation statistics (i.e., dissipation rate, initial deposition, correlation coefficient, etc.) derived from the DFR studies were numerous owing to the many crop groups involved. Therefore, a fuller characterization of their derivation and general application was deferred to Appendix II. Those not familiar with reentry exposure assessment for fieldworkers may also find the appendix beneficial, since it includes a discussion on the *basic* application of DFR for reentry exposure to pesticides.

3. Turf and Other Surface Residues

Other types of surface residues, such as those on sod-farms or golf course turfgrass, generally are not considered to have dissipation properties similar to those on foliage of the more common agricultural commodities. These other types of propargite surface residues are not expected to be available in any appreciable amount anyway, as no propargite uses have been registered in the United States for residential, recreational, or other non-agricultural settings.

4. Other Environmental Concentrations

In completing its environmental risk assessment for propargite, U.S. EPA (2000a) reviewed several field dissipation studies conducted on bare ground plots in California (Lengen, 1989), on cotton plots in California (Harned, 1989), and on citrus plots in Florida (Harned, 1990). These plots were treated with an EC or a WP formulation two or three times at rates ranging from 0.83 to (then label-allowed) 5.2 lb AI/acre. The study on bare ground plots showed the highest maximum propargite level of 5.3 ppm (parts per million) in soil, which was observed in samples collected below the top six-inch soil depth following a second application.

Using the simulation program PRZM-EXAMS designed for estimating drinking water levels, U.S. EPA (2000a) projected a peak surface water level of 26 μg/L for propargite. When the same program was used with the index reservoir and percent crop area factor, a peak surface water level of 34 μg/L was projected. These peak levels are slightly higher than the maximum level of 20 μg/L indicated by the surface water monitoring data from DPR's own program (*see* Section VI-7) and by those from the National Water Quality Assessment (NAWQA) Program conducted by the U.S. Geological Survey. Another simulation program (SCI-GROW) used by U.S. EPA (2000a) predicted a ground water level of 0.006 μg/L.

The above levels of soil and surface water residues were presented here for completeness only. They were not considered in the actual assessment here because dietary exposure (from drinking water) for the general public is beyond the purview of the present exposure assessment. Furthermore, it is not expected that any significant amount of oral intake or dermal uptake of soil residues would occur near a worksite, as this is not a place where children would frequent much (*see* Section VI-7 for further discussion).

V. EXPOSURE ASSESSMENT

All potential exposure scenarios listed in Appendix I (i.e., Tables I-A and I-B) were duly considered in the present exposure assessment. In an effort to further facilitate the assessment discussion, all of these potential exposure scenarios that were classified into the nine worker categories in Subsection II-7, along with bystander/residential exposure, were subsumed under the following three subsections: (1) handler exposure, as from working with propargite for agricultural use; (2) field reentry exposure, as from working in treated fields; and (3) inhalation exposure for bystanders, including residents, to nearby or to ambient airborne propargite residues. The various exposure potentials in these three subsections were considered and estimated systematically as follows.

1. Handler Exposure from Agricultural Use

In the present exposure assessment, the various dermal and inhalation exposure rates used are summarized in Tables 4 through 6, respectively, for all agricultural applicators, mixer/loaders, and mixer/loader/applicators (M/L/applicators, or M/L/A for short) handling various formulations via various application methods. To conserve space, Table 6 also includes the short list of exposure rates for human flaggers guiding aerial spray. All relevant data including the basic assumptions used in all the required calculations are footnoted in these tables. Below are further elaborations on these data and assumptions.

A. Daily Acreage and Application Rates

Maximum application rates for the various formulations and application methods used are specifically listed in Tables 4 through 6, with the maximum rate (currently) being 4.8 lb AI/acre (i.e., that for use of Omite-30WS on avocados). In the present exposure assessment, the maximum daily acreages were assumed to be 600 and 100 for aerial and groundboom sprays (except for ground mixer/loaders) by a single crew, respectively. The estimates used here, while consistent with many of those used by WHS earlier (e.g., Meinders and Krieger, 1988; Dong and Haskell, 2000), were about two times less than the defaults used by U.S. EPA (2001b) for a couple of reasons as explained below.

For maximum daily acreage used in pesticide exposure assessment, currently the interim guidance for WHS is to use the standard values set forth in a U.S. EPA (2001b) policy except when there are more relevant data to the contrary. In fact, even the federal policy explicitly advises that "*(Their) values should be modified by pesticide- and crop-specific knowledge that affects the number of acres that can be treated in a day (e.g., high number of gallons required per acre, specific geographic or cultural practice crop restrictions).*" Therefore, in the case with propargite here, the daily default of 1,200 acres as set forth in the U.S. EPA policy was deemed unrealistic even for high-acre crops (e.g., cotton, corn).

Previously WHS staff (e.g., Meinders and Krieger, 1988) adopted the default of 600 acres in part because of the observations made in yet another earlier study by WHS (Peoples *et al.*, 1981). That earlier study indicated that while the two firms under study each claimed to have treated on average 1,000 acres per day, in the two confirmed cases they each had *two* pilots working separately each day for up to 7 hours from 5 AM to noon, thus yielding a total of 6 to 12 actual hours of spraying each day by *both* pilots in *each firm*.

Table 4. Data and Assumptions Used for Estimation of Propargite Dosage for Applicators from Agricultural Use

Application Method and Formulation/Packaging	Exposure (μg/lb AI handled)[a]			Acres[b] per Day	Rate[c] (lb AI/acre)	Absorbed Daily Dosage (ADD, μg/kg BW/day)[d]			
	Dermal	Hand	Inhalation			Dermal	Hand	Inhalation	Total
EC[e]									
aerial[f]	52.2	96.3	0.57	600	4.5	34.2[e]	63.2[e]	22.0	119.4
airblast[g]	1,010	645.0	5.4	50	4.5	55.2[e]	35.2[e]	17.4	107.8
groundboom[h]	20.9	45.6	1.2	100	2.5	1.2[e]	2.7[e]	4.2	8.2
WSB[i]									
aerial[f]	52.2	96.3	0.57	600	4.0	304.3	561.3	19.5	885.1
airblast[g]	1,010	645.0	5.4	50	4.8	588.6	376.0	18.6	983.2
groundboom[h]	20.9	45.6	1.2	100	2.9	14.7	32.1	5.0	51.8

[a] from the Pesticide Handler Exposure Database (PHED, 1995) subsets used, based on normal work clothing (i.e., long pants, long sleeves, shoes plus socks, no gloves); dermal = total dermal – hand.

[b] default maximum acres/day, as discussed in text (Subsection V-1.A: *Daily Acreage and Application Rates*).

[c] maximum label rate.

[d] total absorbed dosage (μg/kg/day) = [(dermal + hand + inhalation) absorbed dosage] = [{(dermal plus hand exposure rate) x (17% dermal absorption, *see* Subsection III-2) + (inhalation exposure rate) x (100% default inhalation absorption, *see* Subsection III-2)} x {(application rate) x (acres/day) x (70 kg default body weight BW, Thongsinthusak *et al*., 1993 and U.S. EPA, 1997)$^{-1}$}].

[e] *e*mulsifiable *c*oncentrate (Comite, Omite-6E); as common practice (Thongsinthusak *et al*., 1993), dermal and hand exposures based on the PHED estimates were reduced 90% to account for protection from using additional personal protective equipment, as handlers working with these products are required to wear coveralls over normal work clothes, plus headgear and chemical-resistant gloves (as per label specifications).

[f] from PHED subset presented in Appendix III-A.

[g] from PHED subset presented in Appendix III-B.

[h] from PHED subset presented in Appendix III-C.

[i] *w*ater *s*oluble *b*ag (Omite-30 WS); handlers working with this product are not required to wear coveralls, gloves, or headgear.

Table 5. Data and Assumptions Used for Estimation of Propargite Dosage for Mixer/Loaders from Agricultural Use

Application Method and Formulation/Packaging	Exposure (µg/lb AI handled)[a]			Acres[b] per Day	Rate[c] (lb AI/acre)	Absorbed Daily Dosage (ADD, µg/kg BW/day)[d]			
	Dermal	Hand	Inhalation			Dermal	Hand	Inhalation	Total
EC[e]									
for aerial[f]	433.0	582.0	2.4	600	4.5	4.8[e]	19.1[e]	4.6[e]	28.5
for airblast[f]	433.0	582.0	2.4	200	4.5	1.6[e]	6.4[e]	1.6[e]	9.6
for groundboom[f]	433.0	582.0	2.4	200	2.5	0.8[e]	3.6[e]	0.8[e]	5.2
WSB[g]									
for aerial[h]	18.3	0.56	0.28	600	4.0	106.7	0.3[g]	9.6	116.6
for airblast[h]	18.3	0.56	0.28	200	4.8	42.6	0.1[g]	3.8	46.6
for groundboom[h]	18.3	0.56	0.28	200	2.9	25.8	0.08[g]	2.4	28.2

[a] from the Pesticide Handler Exposure Database (PHED, 1995) subsets used, based on normal work clothing (i.e., long pants, long sleeves, shoes plus socks, no gloves); dermal = total dermal – hand; the various scenarios included here are basically in line with those included in Table 4 for applicators.

[b] default maximum acres/day, as discussed in text (Subsection V-1.A: *Daily Acreage and Application Rates*).

[c] maximum label rate.

[d] total absorbed dosage (µg/kg/day) = [(dermal + hand + inhalation) absorbed dosage] = [{(dermal plus hand exposure rate) x (17% dermal absorption, *see* Subsection III-2) + (inhalation exposure rate) x (100% default inhalation absorption, *see* Subsection III-2)} x {(application rate) x (acres/day) x (70 kg default body weight BW, Thongsinthusak *et al*., 1993 and U.S. EPA, 1997)$^{-1}$}].

[e] *e*mulsifiable *c*oncentrate (Comite, Omite-6E); as common practice (Thongsinthusak *et al*., 1993), dermal, hand, and inhalation exposures based on the PHED estimates were reduced 99.83%, 99.5%, and 95%, respectively, to account for protection from using additional personal protective equipment, as handlers working with these products are required to use a closed system for mixing and loading (95% reduction); *in addition*, they are required to wear coveralls over normal work clothes, plus headgear and chemical-resistant gloves (hence a further 90% reduction for dermal and hand, leading to a total of 99.5% reduction), and a chemical-resistant apron (hence another 66.7% reduction for dermal leading to a final total of 99.83% reduction, based on the assumption that apron covers up to 60 - 80% of the body's anterior part which is most vulnerable to dermal exposure).

[f] from PHED subset presented in Appendix III-D.

[g] *w*ater *s*oluble *b*ag (Omite-30 WS); as common practice (Thongsinthusak *et al*., 1993), hand exposure based on the PHED estimates was reduced 90%, as handlers using this product are required to wear gloves; with this product, handlers are not required to use a closed system, as by policy the water soluble packaging qualifies as a closed mixing system.

[h] from PHED subset presented in Appendix III-E.

Table 6. Data and Assumptions Used for Estimation of Propargite Dosage for Mixer/Loader/Applicators and Human Flaggers from Agricultural Use

Application Method and Formulation/Packaging	Exposure (µg/lb AI handled)[a]			Acres[b] per Day	Rate[c] (lb AI/acre)	Absorbed Daily Dosage (ADD, µg/kg BW/day)[d]			
	Dermal	Hand	Inhalation			Dermal	Hand	Inhalation	Total
Human Flagger[e]									
EC[f]	37.4	6.0	0.2	600	4.5	24.5[f]	3.9[f]	7.7	36.2
WSB	37.4	6.0	0.2	600	4.0	218.0	35.0	6.9	259.8
M/L/Applicator[g]									
low pressure sprayer[h]	11,600	34,300	1,040	1	0.45	12.7	3.7[g]	6.7	23.1
high pressure sprayer[i]	6,580	3,390	151.0	5	0.45	36.0	1.9[g]	4.9	42.7
backpack sprayer[j]	22,300	96.8	17.5	1	0.45	24.4	0.01[g]	0.1	24.5

[a] from the Pesticide Handler Exposure Database (PHED, 1995) subsets used, based on normal work clothing (i.e., long pants, long sleeves, shoes plus socks, no gloves); dermal = total dermal – hand.

[b] default maximum acres/day, as discussed in text (Subsection V-1.A: *Daily Acreage and Application Rates*).

[c] maximum label rate.

[d] total absorbed dosage (µg/kg/day) = [(dermal + hand + inhalation) absorbed dosage] = [{(dermal plus hand exposure rate) x (17% dermal absorption, *see* Subsection III-2) + (inhalation exposure rate) x (100% default inhalation absorption, *see* Subsection III-2)} x {(application rate) x (acres/day) x (70 kg default body weight BW, Thongsinthusak *et al*., 1993 and U.S. EPA, 1997)$^{-1}$}].

[e] from PHED subset presented in Appendix III-F.

[f] EC = *e*mulsifiable *c*oncentrate (Comite, Omite-6E); as common practice (Thongsinthusak *et al*., 1993), dermal and hand exposures from the PHED estimates were reduced 90% to account for protection from using additional personal protective equipment (PPE), as handlers working with the two EC products are required to wear coveralls over normal work clothes plus headgear and chemical-resistant gloves (as per label specifications); such coveralls requirement is not specified on the label for the water soluble bag (WSB) product Omite-30WS.

[g] for mixer/loader/applicator (i.e., M/L/applicator) using the Omite-30WS product only; as common practice (Thongsinthusak *et al*., 1993), hand exposure based on the PHED estimate was reduced by 90% to account for protection from wearing gloves (as required by state regulations when workers apply pesticides using handheld equipment); note that the three handler scenarios are included for completeness only, otherwise not considered too practical here since the entire soluble bag must be used and each bag calls for a minimum of 17 gallons of spray solution per acre (e.g., for application to peanuts); one slight possibility of such use is when a high or low pressure handwand is attached to a tank with a capacity for 20 or more gallons of solution, or when the spray solution is prepared in a sufficiently large mixing tank from which, however impractical it might be, the solution is poured into a backpack tank several times during the course of the pesticide spray.

[h] from PHED subset presented in Appendix III-G

[i] from PHED subset presented in Appendix III-H.

[j] from PHED subset presented in Appendix III-I.

Another reason why the WHS default is used here is that, to a great extent, the PUR data for the 10 most recent available years (2002 through 2011) at this time (i.e., as of December 2013) also supported the use of 600 acres as the default for aerial application of propargite (DPR, 2013). When the PUR data were extracted by propargite, grower ID, aerial application, application date, and application use number, each year's highest acreage treated per a single aerial application (as per use number) was found to be 620 or lower in each of the 10 years between 2002 and 2011, with an average of 390 for the 10 yearly highest (450, 620, 449, 432, 380, 311, 350, 290, 299, and 315, respectively).

Note that one of the output columns available in the California Pesticide Information Portal (DPR, 2013) is *sequential* use number (Use_Number), which is used to uniquely identify all records associated with a *single* particular application of a product and hence by definition is date-, grower-, and even applicator-specific. Although it is possible that growers each can have aerial applications done to two (or more) nearby fields on the same day, it is unlikely for them to use two different use numbers for two fields that they treat *on the same day* as if they should be treated separately not under a single large operation (i.e., not under the same use number), especially if the applications were to be performed by the same pilot. A closer look at the PUR data also showed that each year only a very few application use numbers from the same day appeared in consecutive order, inferring that all those applications occurring on the same days were not likely made by the same pilot or the same aerial crew.

U.S. EPA (2001b) uses 40, 80, and 200 acres per day as the defaults for airblast application and for groundboom spray to low- and high-acre crops, respectively. In the present exposure assessment, the maximum daily acreage for groundboom application was assumed to be 100, primarily due to the worker's physical limitation involved. Further justification is given in the Exposure Appraisal for using 100 acres as the maximum daily default for groundboom sprays (except for ground mixer/loaders, as noted and justified below).

For airblast applicators, the maximum daily acreage assumed in this exposure assessment was presumed to be half (i.e., 50 acres per day) of that for groundboom applicators. This presumption, while consistent with U.S. EPA's practice, was based more on the observation that it tends to take twice the time and effort for an applicator to maneuver an airblast spray rig than to drive a groundboom tractor around in a field. In an orchard where an airblast sprayer is most applicable, an applicator often needs to maneuver with extra attention in order to free their rig from the tall and fully grown trees surrounding the work area. In fact, up to 11 hours were reportedly required for a single applicator to airblast propargite to 50 acres of grapes in a vineyard (e.g., Jones, 1988a). The maximum daily acreage of 200 for *all* ground *mixer/loaders*, which is consistent with U.S. EPA's default, is likely unaffected by the presumption made above. This is because these handlers each can serve more than one airblast or groundboom applicator in a workday. What matters most here is the physical limitation involved for each mixer/loader in a day's work which includes cleaning the equipment, while taking into account the potential that more or less efficient equipment is used to offer hence more or less (respectively) spray solutions for certain ground application methods. The present exposure assessment had set the maximum daily acreage at 200 for this handler group, instead of 100 as in some other exposure assessment documents (e.g., for simazine), all because these workers might engage in *more* the larger-sized field/row crops.

For M/L/applicators using the three major types of handheld equipment, the defaults used as maximum daily acreage were largely comparable to those used by U.S. EPA (2001b). The defaults used in this exposure assessment were 5 (acres/day) for high pressure sprayers and 1 for either backpack or low pressure sprayers. U.S. EPA's defaults for using handgun and backpack type sprayers are 1,000 and 40 gallons of spray solution per day, respectively. After unit conversion and adjustment for time spent per workday, the defaults adopted by U.S. EPA (2001b) for M/L/applicators and those used here were considered comparable.

B. Data on Exposure Rates

In accordance with U.S. EPA's findings (Tadayon, 2000), there appeared to be only three chemical-specific worker exposure studies available for evaluation. One worker exposure monitoring study (Jones, 1988a) involved airblast application to grapes. The other two studies were submitted by the then registrant Uniroyal Chemical, with one likewise involving airblast application but to apples instead (Jones and Rotondaro, 1991a). The third study involved groundboom application to cotton (Jones and Rotondaro, 1991b). All three studies were found *not* acceptable for use to estimate handler exposures because each used only *a single* worker as test subjects. In the present exposure assessment, the inhalation and dermal exposure rates used for the various handler groups were hence all necessarily based on the arithmetic means derived from the Pesticide Handler Exposure Data (PHED, 1995) surrogate subsets, which are appended to the end of this document (as Appendices III-A through III-I) and described below.

PHED was developed by the U.S. EPA, Health Canada, and the American Crop Protection Association to provide nonchemical-specific pesticide handler exposure estimates for specific handler scenarios. It combines handler exposure data from multiple field monitoring studies of different pesticides. The user is supposed to select a subset of the data that involves a similar application method and formulation type as the target exposure scenario. The use of nonchemical-specific exposure estimates is based on two generally accepted but not yet fully validated assumptions (Versar, 1992): (1) Handler exposure is primarily a function of formulation type and pesticide application method or equipment, and not much of the physical or chemical properties of the specific AI involved; and (2) handler exposure is proportional to the amount of AI handled, at least within a practical range (*see* the Exposure Appraisal for further discussion).

When using surrogate data to estimate acute or short-term exposure, WHS uses the 90% upper confidence limit (UCL) on the 95th percentile. The UCL is used to account for some of the uncertainties inherent in using surrogate data and to increase the confidence in the estimate. Confidence limits on percentiles (a.k.a. tolerance limits) are described in Hahn and Meeker (1991). Estimating the UCL requires knowing the mean and the associated standard deviation. PHED calculates and reports the mean of total dermal exposure, but only the coefficients of variation (CV) for separate body regions. Because the sample sizes per body region differ and because the correlations among body regions are unknown, the standard deviation of total dermal exposure cannot be calculated from these body region-specific CV.

In order to approximate the upper (and lower) confidence limits for the 95th percentile, WHS makes the assumption that total dermal exposure is lognormally distributed across persons and has a CV of 100 percent. The method of approximation is described in Frank (2007), and uses the concept that in any lognormal distribution with a given CV, the UCL for a percentile is a constant multiple of the arithmetic mean. The value of the multiplier then depends only on sample size. To use the approximation with PHED data, the multipliers corresponding to the median sample sizes over the major specific body regions (i.e., inhalation, hand, and rest of body) are used. For example, if the median sample size for hand is between 20 and 119, the multiplier is 4; if the median sample size is between 12 and 19, the multiplier is 5. Multipliers are given in Tables 7, 8, and 9, where estimates of ADDs specific to exposure duration are presented for the various groups of propargite handlers. The actual numbers of observations (i.e., median sample sizes) for the various body regions are given in the PHED subsets appended to this document (i.e., as Appendices III-A through III-I).

When using surrogate data to estimate intermediate- or long-term exposure, WHS uses the 90% UCL on the arithmetic mean. This UCL is used for the reasons stated above for short-term or acute exposure. As with short-term exposure estimates based on PHED subsets, multipliers corresponding to the median sample sizes over the three major body regions are used. For example, if the median sample size for hand is between 6 and 14, the multiplier is rounded to 2; if the sample size is greater than 15, no multiplier is used since its numerical value is (rounded to) 1.

C. Applicators

As indicated in Table 4, propargite applicators were divided into six subgroups according to product formulation/packaging and type of equipment used. These six subgroups are: (A) pilots (operators) broadcasting propargite EC (subgroup A1) or WSB (subgroup A2) to crops from an aircraft; (B) operators applying propargite EC (B1) or WSB (B2) to tree crops or grapes using an airblast sprayer; and (C) operators applying propargite EC (C1) or WSB (C2) to field or row crops using a groundboom sprayer.

Although the above six applicator subgroups all apply propargite in a spray solution, there is a need in this assessment to separate their use of the WSB product from those of the EC. Handlers working with the EC products are additionally required to wear coveralls over normal work clothes, plus chemical-resistant gloves and headgear. In contrast, applicators working with the WSB are not required to wear gloves or coveralls over normal work clothes. Thus, as footnoted in Table 4, appropriate adjustments for dermal and hand exposures were made for those handling the EC products.

As justified in the preceding subsection, acceptable chemical-specific studies were not available for use to assess handler exposure to propargite. Data from PHED subsets were thus used to surrogate the exposure rates for the six applicator subgroups, as footnoted in Table 4.

D. Mixer/Loaders

As indicated in Table 5, propargite mixer/loaders were likewise divided into six subgroups according to product formulation/packaging and type of equipment used. These six subgroups are: (A) workers mixing/loading an propargite EC product for aerial (A1), airblast (A2), or groundboom (A3) application; and (B) workers mixing/loading the WSB product for aerial (B1), airblast (B2), or groundboom (B3) application.

State regulations (Title 3, *CCR*, Section 6738) specify that mixer/loaders are required to wear gloves. When handling more than 1 gallon of propargite liquid, they are additionally required to use a closed system for mixing/loading. In addition, when working with an EC, they are required to wear coveralls over normal work clothes, plus headgear, chemical-resistant gloves, and a chemical-resistant apron. Therefore, as footnoted in Table 5 (*see* footnote *e*), appropriate adjustments for dermal, hand, and inhalation exposures were made for these workers handling the EC and WSB products under the specific engineering control or PPE requirement.

As stated in the preceding subsection, there were no acceptable chemical-specific studies available for use to assess handler exposure to propargite. Therefore, data from PHED subsets were used to surrogate the exposure rates for these six mixer/loader subgroups, as footnoted in Table 5.

E. Human Flaggers

As indicated in Table 6, human flaggers were divided into two subgroups according to product formulation/packaging used. These two subgroups are: (A) workers guiding aerial application of EC; and (B) workers guiding aerial application of WSB.

Human flaggers working with the EC formulation are required to wear coveralls over normal work clothes, plus chemical-resistant gloves and headgear. Therefore, as footnoted in Table 6, appropriate adjustments for dermal and hand exposures were made for human flaggers handling an EC product.

As stated in the preceding subsection, there were no acceptable chemical-specific studies available for use to assess handler exposure to propargite. Data from PHED subsets were thus used to surrogate the exposure rates for these two human flagger subgroups, as footnoted in Table 6.

F. Mixer/Loader/Applicators

As also indicated in Table 6, M/L/applicators were divided into three subgroups according to the (major) type of handheld spray equipment used. These three subgroups are operators mixing, loading, *and* applying the WSB formulation using: (A) a low pressure handwand or handgun type sprayer; (B) a high pressure handwand or handgun type sprayer; and (C) a backpack type sprayer.

The EC products are used supposedly for large field operations (e.g., >10 acres/day, as reflected in the crops covered on the two EC labels). Therefore, it is highly unlikely for M/L/A to use these products since these workers cannot do a large-scale field operation all by themselves in a timely manner, particularly when otherwise they would have to put on additional clothing and PPE. It is also questionable that these workers would use even a propargite product in WSB formulation, as the entire water-soluble bag must be all used and each bag calls for a minimum of 17 gallons of spray solution per acre (*see* footnotes in Table 6 for further elaboration). These three WSB-M/L/A use scenarios were included in the present exposure assessment for completeness only. In any case, by state regulations (Title 3, *CCR*, Section 6738), workers using handheld equipment are required to wear gloves.

Accordingly, as footnoted in Table 6, appropriate adjustment for hand exposure was made for these three M/L/A subgroups.

There were likewise no acceptable chemical-specific studies available for use to assess handler exposure to propargite. Thus, data from PHED subsets were used to surrogate the exposure rates for the three M/L/A subgroups, as footnoted in Table 6.

G. Short- and Long-Term Exposures

Tables 7 through 9 provide the estimates of absorbed daily dosage (ADD) for the short-, intermediate-, and long-term worker exposures to propargite under the four handler groups (i.e., applicators, mixer/loaders, M/L/A, and human flaggers) considered in Tables 4 through 6. Here in line with the current guidelines used at WHS, short- and intermediate-terms are defined as up to 7 days and from 8 days to 3 months, respectively. The short- and long-term dosages listed in Tables 7 through 9 were each calculated with their corresponding data and assumptions summarized in Tables 4 through 6. As reflected in footnotes *b*, *c*, and *f* in Tables 7 through 9, three additional variables were required for the calculations. Two of these variables were statistical parameters: (1) one involving the use of the 90% UCL of the 95th percentile as the upper bound for acute/short-term exposure; and (2) the other based on the use of the 90% UCL on the calculated mean as an average ADD for exposures longer- than short-term (as discussed in Subsection V-1.B). The third variable is annual exposure frequency for amortization purposes, as discussed briefly in the following subsection but more extensively in Appendix IV.

H. Exposure Frequency

As common practice at WHS, temporal patterns on use in five most recent years were used to derive estimates of handler exposure frequency, with which the ADDs were later annualized (amortized) for chronic dosage. These frequency patterns (Appendix IV) were investigated by examining percent of use based on pounds per month for the most recent five years for which the PUR were available at the time of the exposure assessment. For the purpose of this exposure assessment, data from the highest-use county over the five-year period from 2007 through 2011 were used as surrogates. Only those monthly uses reaching *five* percent (5%) of the aggregated total in the five-year period were considered as *truly high-use*. These county-based data were further limited to the application method at issue, in order to be consistent with the handler group considered. Since the PUR can separate the data only broadly into those with aerial *versus* ground application, the various ground methods were identified or defined by commodities that tend to be treated with a particular ground method.

Per current practice at WHS and for practical reasons (*see* Appendix IV), those monthly uses reaching 5% were more favorably considered for annualizing chronic dosage. As justified in Appendix IV, 4 months was considered a practical estimate and used as the annual (and the subchronic as well) exposure frequency for each handler group considered in this exposure assessment. It is important to note that the PUR can only be as descriptive as listing each pesticide AI's monthly use by commodity/site, county, pounds, number of applications, acres, application date, gross application method (i.e., air *vs*. ground), etc. The PUR data are not about any handler's *individual* use pattern for any pesticide. Thus, the protocol used here to estimate the annual exposure frequency was necessarily based on a conservative approach,

Table 7. Estimates of Absorbed Daily Dosages (ADD, in µg/kg/day) for Applicators from Agricultural Use of Propargite

Application Method/ Formulation/ Packaging[a]	Dermal Exposure			Hand Exposure			Inhalation Exposure			Acute ADD[d]	Seasonal ADD[e]	Annual ADD[f]	Lifetime ADD[g]
	ADD[a]	Ma[b]	Ms[c]	ADD[a]	Ma[b]	Ms[c]	ADD[a]	Ma[b]	Ms[c]				
EC[h]													
aerial	34.2	6	2	63.2	6	2	22.0	5	2	694.4	238.8	79.6	42.5
airblast	55.2	4	1	35.2	4	1	17.4	4	1	431.2	107.8	35.9	19.2
groundboom	1.2	4	1	2.7	4	1	4.2	4	1	32.4	8.1	2.7	1.4
WSB[i]													
aerial	304.3	6	2	561.3	6	2	19.5	5	2	5,291.1	1,770.2	590.1	314.7
airblast	588.6	4	1	376.0	4	1	18.6	4	1	3,932.8	983.2	327.7	174.8
groundboom	14.7	4	1	32.1	4	1	5.0	4	1	207.2	51.8	17.3	9.2

[a] average ADD from Table 4 in this document; dermal = total dermal – hand.

[b] Ma ≡ multiplier for acute exposure, as provided in the Pesticide Handler Exposure Database (PHED, 1995) subset used for the ADD in Table 4.

[c] Ms ≡ multiplier for subchronic exposure, as provided in the Pesticide Handler Exposure Database (PHED, 1995) subset used for the ADD in Table 4.

[d] acute ADD (total) = [(average ADD) x (Ma), for dermal] + [(average ADD) x (Ma), for hand] + [(average ADD) x (Ma), for inhalation].

[e] each intermediate-term (subchronic) or seasonal ADD (SADD) total was calculated in a manner similar to that for the acute ADD total, except that it has its own set of multipliers Ms.

[f] annual or annualized ADD (AADD) = SADD x (annual use months per year, here 4 months was assumed, *see* Subsection V-1.H) x (12 months in a year)$^{-1}$.

[g] lifetime ADD (LADD) = AADD x (40 years of work in a lifetime) x (75 years in a lifetime)$^{-1}$.

[h] *e*mulsifiable *c*oncentrate (Comite, Omite-6E); handlers working with these two EC products are required to wear coveralls over normal work clothes, plus headgear and chemical-resistant gloves (as per label specifications and so accounted for already in Table 4).

[i] *w*ater *s*oluble *b*ag (Omite-30WS); handlers working with this product are not required to wear coveralls, gloves, or headgear.

Table 8. Estimates of Absorbed Daily Dosages (ADD, in µg/kg/day) for Mixer/Loaders from Agricultural Use of Propargite

Application Method/ Formulation/ Packaging[a]	Dermal Exposure			Hand Exposure			Inhalation Exposure			Acute ADD[d]	Seasonal ADD[e]	Annual ADD[f]	Lifetime ADD[g]
	ADD[a]	Ma[b]	Ms[c]	ADD[a]	Ma[b]	Ms[c]	ADD[a]	Ma[b]	Ms[c]				
EC[h]													
for aerial	4.8	4	1	19.1	4	1	4.6	4	1	113.6	28.4	9.5	5.0
for airblast	1.6	4	1	6.4	4	1	1.6	4	1	37.8	9.4	3.2	1.6
for groundboom	0.8	4	1	3.6	4	1	0.8	4	1	21.0	5.2	1.8	1.0
WSB[i]													
for aerial	106.7	5	2	0.3	9	2	9.6	5	2	584.3	233.2	77.7	41.5
for airblast	42.6	5	2	0.1	9	2	3.8	5	2	233.8	93.2	31.0	16.6
for groundboom	25.8	5	2	0.08	9	2	2.4	5	2	141.2	56.4	18.8	10.0

[a] average ADD from Table 5 in this document; dermal = total dermal – hand.

[b] Ma ≡ multiplier for acute exposure, as provided in the Pesticide Handler Exposure Database (PHED, 1995) subset used for the ADD in Table 5.

[c] Ms ≡ multiplier for subchronic exposure, as provided in the Pesticide Handler Exposure Database (PHED, 1995) subset used for the ADD in Table 5.

[d] acute ADD (total) = [(average ADD) x (Ma), for dermal] + [(average ADD) x (Ma), for hand] + [(average ADD) x (Ma), for inhalation].

[e] each intermediate-term (subchronic) or seasonal ADD (SADD) total was calculated in a manner similar to that for the acute ADD total, except that it has its own set of multipliers Ms.

[f] annual or annualized ADD (AADD) = SADD x (annual use months per year, here 4 months was assumed, *see* Subsection V-1.H) x (12 months in a year)$^{-1}$.

[g] lifetime ADD (LADD) = AADD x (40 years of work in a lifetime) x (75 years in a lifetime)$^{-1}$.

[h] *e*mulsifiable *c*oncentrate (Comite, Omite-6E); handlers working with these two EC products are required to wear coveralls over normal work clothes, plus headgear and chemical-resistant gloves, and use a closed system for mixing/loading (all as so accounted for already in Table 5).

[i] *w*ater *s*oluble *b*ag (Omite-30WS); handlers working with this product are required to wear gloves (as so accounted for already in Table 5).

Table 9. Estimates of Absorbed Daily Dosages (ADD, in µg/kg/day) for Mixer/Loader/Applicators and Human Flaggers from Agricultural Use of Propargite

Application Method/ Formulation/ Packaging[a]	Dermal Exposure			Hand Exposure			Inhalation Exposure			Acute ADD[d]	Seasonal ADD[e]	Annual ADD[f]	Lifetime ADD[g]
	ADD[a]	Ma[b]	Ms[c]	ADD[a]	Ma[b]	Ms[c]	ADD[a]	Ma[b]	Ms[c]				
Human Flagger													
EC[h]	24.5	4	1	3.9	4	1	7.7	4	1	144.4	36.1	12.0	6.4
WSB[i]	218.0	4	1	35.0	4	1	6.9	4	1	1,039.6	259.9	86.6	46.2
M/L/Applicator[j]													
low pressure	12.7	5	1	3.7	5	1	6.7	5	1	115.5	23.1	7.7	4.1
high pressure	36.0	5	2	1.9	5	2	4.9	5	2	213.3	85.3	28.4	15.2
backpack	24.4	6	2	0.01	6	2	0.1	6	2	147.1	49.0	16.3	8.7

[a] average ADD from Table 6 in this document; dermal = total dermal – hand.

[b] Ma ≡ multiplier for acute exposure, as provided in the Pesticide Handler Exposure Database (PHED, 1995) subset used for the ADD in Table 6.

[c] Ms ≡ multiplier for subchronic exposure, as provided in the Pesticide Handler Exposure Database (PHED, 1995) subset used for the ADD in Table 6.

[d] acute ADD (total) = [(average ADD) x (Ma), for dermal] + [(average ADD) x (Ma), for hand] + [(average ADD) x (Ma), for inhalation].

[e] each intermediate-term (subchronic) or seasonal ADD (SADD) total was calculated in a manner similar to that for the acute ADD total, except that it has its own set of multipliers Ms.

[f] annual or annualized ADD (AADD) = SADD x (annual use months per year, here 4 months was assumed, *see* Subsection V-1.H) x (12 months in a year)$^{-1}$.

[g] lifetime ADD (LADD) = AADD x (40 years of work in a lifetime) x (75 years in a lifetime)$^{-1}$.

[h] *e*mulsifiable *c*oncentrate (Comite, Omite-6E); handlers working with these two EC products are required to wear coveralls over normal work clothes, plus headgear and chemical-resistant gloves (as per label specifications and so accounted for already in Table 6).

[i] *w*ater *s*oluble *b*ag (Omite-30WS); handlers working with this product are required to wear waterproof gloves, but not coveralls or headgear (as per label specifications and so accounted already for in Table 6).

[j] from Table 6 for mixer/loader/applicator (i.e., M/L/applicator) using the Omite-30WS product; handlers are required to wear gloves (as required by state regulations when workers apply pesticides using handheld equipment), and such glove protection was accounted for in Table 6; note that the three handler scenarios are included for completeness only, otherwise not considered too practical here since the entire soluble bag must be used and each bag calls for a minimum of 17 gallons of spray solution per acre (e.g., for application to peanuts); one slight possibility of such use is when a high or low pressure handwand is attached to a tank with a capacity for 20 or more gallons of solution, or when the spray solution is prepared in a sufficiently large mixing tank from which, however impractical it might be, the solution is poured into a backpack tank several times during the course of the pesticide spray.

assuming that one handler is getting all possible long-term exposures as if this worker were the only person using the material so characterized by the PUR data.

I. Dermal Concentrations on Handlers

In addition to the absorbed dosages for systemic effects, there was a need for calculating the dermal concentrations (i.e., unabsorbed doses) for the handlers in order to account for the potential *non*-systemic skin irritation effect caused by propargite. In this assessment, as in some other pesticide exposure assessments by WHS (e.g., Dong and Haskell, 2000), dermal concentration is referred to as the amount of propargite residues present *on* a worker's skin surface, and is typically expressed as µg of pesticide residues per cm^2 of the surface area considered. In essence, this is the dermal dose ($\mu g/cm^2$) not yet absorbed into the skin.

The dermal concentrations of propargite calculated for acute and subchronic exposures of the four handler groups are given in Tables 10 through 15, along with footnotes indicating the basic algorithm and assumptions used. More specifically, Tables 10 through 12 are for *acute* exposures of applicators, mixer/loaders, and M/L/applicators together with human flaggers, respectively, whereas Tables 13 through 15 are for *subchronic* exposures of the same four handler groups, respectively. Note that those dermal doses calculated for subchronic exposures can be used for chronic exposures as well. However, they were not considered or amortized in the present exposure assessment because skin irritation type localized effects are rarely caused by long-term exposure. Further elaboration on the use of the algorithm and assumptions was deferred to Appendix VI.

2. Reentry Exposure Following Agricultural Use

As per their job functions, many groups of fieldworkers are subject to dermal exposure from potentially intensive dermal contact with dislodgeable propargite residues present on treated foliage. These fieldworker groups include (but are not limited to) hand harvesters, irrigation workers (herein irrigators), cotton/corn scouts, and those performing cane turning, shoot turning, leaf pulling, pruning, or girdling (especially in grape vineyards). To estimate their reentry exposures for each day or for certain days, it was necessary to extrapolate the dermal exposure from available DFR data. As further described in Appendix II, this extrapolation was accomplished by means of a dermal transfer rate (TR). Also included in that appendix is an elaboration on why DFR data should be used to estimate reentry exposures for field-workers. In essence, the extrapolation algorithm used was based on the well-received, but not fully validated, assumption used in pesticide exposure assessment:

Exposure = (Contact or Transfer Rate) x *(Residue Concentration).*

In this case for field reentry exposure, residue concentration is the DFR level, which is not only time-dependent but presumably also specific to a cluster of crops for the reasons given in Appendix II. The dermal TR, on the other hand, is specific to the reentry activity at issue. Because the reentry exposures so extrapolated are based primarily on the amount of DFR that workers contact, the DFR at either REI or PHI (pre-harvest interval) were used for short-term exposures, and those foliar residues at an average reentry interval were used for exposures other than short-term or acute. This approach is considered reasonable in that the earliest

Table 10. Dermal Doses (μg/cm^2) for Localized Skin Effects of Propargite, from *Acute* Exposures of Applicators[a,b]

Formulation/Method[a]	**HEAD**	**NECK**	**U. ARM**	**CHEST**	**BACK**	**F. ARM**	**THIGH**	**L. LEG**	**FEET**	**DERMAL**	**HAND**	**DOSAGE**[c]	
PHED Surface Area, cm^2	*1,300*	*260*	*2,910*	*3,550*	*3,550*	*1,210*	*3,820*	*2,380*	*1,310*	*20,290*	*820*	*Hand*	*Dermal*
EC aerial	4.2	0.7	8.6	6.3	8.7	2.8	9.6	7.4	3.8	52.1	96.3	379.2	205.2
dermal dose (μg/cm^2)	**5.2**	**4.4**	**4.8**	**2.9**	**4.0**	**3.7**	**4.1**	**5.0**	**4.8**	**4.2**	**190.4**		
EC airblast	778.6	65.0	42.4	21.8	14.7	7.5	56.8	17.3	9.0	1,013.1	645.0	140.8	220.8
dermal dose (μg/cm^2)	**53.7**	**22.4**	**1.3**	**0.6**	**0.4**	**0.6**	**1.3**	**0.7**	**0.6**	**4.5**	**70.7**		
EC groundboom	2.8	2.6	1.7	1.8	3.0	2.7	3.1	2.1	1.1	20.9	45.6	10.8	4.8
dermal dose (μg/cm^2)	**0.2**	**0.9**	**0.06**	**0.05**	**0.1**	**0.2**	**0.1**	**0.1**	**0.1**	**0.1**	**5.4**		
WSB aerial	4.2	0.7	8.6	6.3	8.7	2.8	9.6	7.4	3.8	52.1	96.3	3,367.8	1,825.8
dermal dose (μg/cm^2)	**46.6**	**38.8**	**42.6**	**25.6**	**35.3**	**33.4**	**36.2**	**44.8**	**42.3**	**37.1**	**1,691.1**		
WSB airblast	778.6	65.0	42.4	21.8	14.7	7.5	56.8	17.3	9.0	1,013.1	645.0	1,504.0	2,354.4
dermal dose (μg/cm^2)	**573.1**	**239.2**	**13.9**	**5.9**	**4.0**	**5.9**	**14.2**	**7.0**	**6.6**	**47.8**	**755.2**		
WSB groundboom	2.8	2.6	1.7	1.8	3.0	2.7	3.1	2.1	1.1	20.9	45.6	128.4	58.8
dermal dose (μg/cm^2)	**2.5**	**11.6**	**0.7**	**0.6**	**1.0**	**2.6**	**0.9**	**1.0**	**1.0**	**1.2**	**64.5**		

[a] based on Table 7; listed right above each of the calculated dermal doses (i.e., above each of those in bold) is the dermal exposure rate (μg/lb active ingredient handled) from PHED subsets attached in Appendix III (namely III-A, III-B, and III-C).

[b] as an example for calculation of dermal dose: dermal dose (chest, WSB groundboom) = [(1.8 μg/lb x (20.9 μg/lb)$^{-1}$, portion of dermal exposure rate attributed to chest) x (58.8 μg/kg BW/day, dermal absorbed dosage) x (17% dermal absorption)$^{-1}$ x (70 kg BW)] x (3,550 cm^2, surface area for chest)$^{-1}$ = 0.6 μg/cm^2, where BW = body weight; U. Arm = upper arm; F. Arm = forearm; L. Leg = lower leg; EC = emulsifiable concentrate; WSB = water soluble bag; note that the portion of dermal exposure rate attributed to chest is based on PHED subset in Appendix III-C (i.e., the 1.8 μg/lb is from the CHEST column and the 20.9 μg/lb is from the DERMAL column in this table, both for WSB groundboom); s*ee* Appendix VI for further detail on algorithm and assumptions used.

[c] acute dosages for *hand* and *dermal* in the last two columns are in μg/kg BW/day (as shown in Table 7), based on a dermal absorption of 17% and after taking the appropriate multipliers into account.

Table 11. Dermal Doses (μg/cm^2) for Localized Skin Effects of Propargite, from *Acute* Exposures of Mixer/Loaders[a,b]

Formulation/Method[a]	**HEAD**	**NECK**	**U. ARM**	**CHEST**	**BACK**	**F. ARM**	**THIGH**	**L. LEG**	**FEET**	**DERMAL**	**HAND**	**DOSAGE**[c]	
PHED Surface Area, cm^2	*1,300*	*260*	*2,910*	*3,550*	*3,550*	*1,210*	*3,820*	*2,380*	*1,310*	*20,290*	*820*	*Hand*	*Dermal*
EC aerial	128.0	38.6	157.7	19.0	10.9	4.4	16.6	37.8	19.7	432.7	45.6	76.4	18.8
dermal dose (μg/cm^2)	**1.8**	**2.7**	**1.0**	**0.1**	**0.1**	**0.1**	**0.1**	**0.3**	**0.3**	**0.4**	**38.4**		
EC airblast	128.0	38.6	157.7	19.0	10.9	4.4	16.6	37.8	19.7	432.7	45.6	25.6	6.4
dermal dose (μg/cm^2)	**0.6**	**1.0**	**0.4**	**0.04**	**0.02**	**0.02**	**0.02**	**0.10**	**0.10**	**0.1**	**12.8**		
EC groundboom	128.0	38.6	157.7	19.0	10.9	4.4	16.6	37.8	19.7	432.7	45.6	14.4	3.6
dermal dose (μg/cm^2)	**0.2**	**0.4**	**0.2**	**0.02**	**0.010**	**0.02**	**0.02**	**0.04**	**0.04**	**0.06**	**7.1**		
WSB aerial	3.5	0.7	2.6	1.8	1.8	1.1	4.9	1.2	0.6	18.2	0.6	2.9	533.5
dermal dose (μg/cm^2)	**32.5**	**32.5**	**10.8**	**6.1**	**6.1**	**11.0**	**15.5**	**6.1**	**5.7**	**10.8**	**1.5**		
WSB airblast	3.5	0.7	2.6	1.8	1.8	1.1	4.9	1.2	0.6	18.2	0.6	1.2	213.3
dermal dose (μg/cm^2)	**13.0**	**13.0**	**4.2**	**2.4**	**2.4**	**4.4**	**6.2**	**2.4**	**2.2**	**4.4**	**0.6**		
WSB groundboom	3.5	0.7	2.6	1.8	1.8	1.1	4.9	1.2	0.6	18.2	0.6	0.7	128.9
dermal dose (μg/cm^2)	**7.8**	**7.8**	**2.6**	**1.4**	**1.4**	**2.6**	**3.8**	**1.4**	**1.4**	**2.6**	**0.4**		

[a] based on Table 8; listed right above each of the calculated dermal doses (i.e., above each of those in bold) is the dermal exposure rate (μg/lb active ingredient handled) from PHED subsets attached in Appendix III (namely III-D and III-E).

[b] as an example for calculation of dermal dose: dermal dose (thigh, WSB aerial) = [(4.9 μg/lb x (18.2 μg/lb)$^{-1}$, portion of dermal exposure rate attributed to thigh) x (533.5 μg/kg BW/day, dermal absorbed dosage) x (17% dermal absorption)$^{-1}$ x (70 kg BW)] x (3,820 cm^2, surface area for thigh)$^{-1}$ = 15.46 μg/cm^2, where BW = body weight; U. Arm = upper arm; F. Arm = forearm; L. Leg = lower leg; EC = emulsifiable concentrate; WSB = water soluble bag; note that the portion of dermal exposure rate attributed to thigh is based on PHED subset in Appendix III-E (i.e., the 4.9 μg/lb is from the THIGH column and the 18.2 μg/lb is from the DERMAL column in this table, both for WSB aerial); s*ee* Appendix VI for further detail on algorithm and assumptions used.

[c] acute dosages for *hand* and *dermal* in the last two columns are in μg/kg BW/day (as shown in Table 8), based on a dermal absorption of 17% and after taking the appropriate multipliers into account.

Table 12. Dermal Doses (µg/cm^2) for Localized Skin Effects of Propargite, from *Acute* Exposures of Human Flaggers and Mixer/Loader/Applicators[a,b]

Formulation/Method[a]	**HEAD**	**NECK**	**U. ARM**	**CHEST**	**BACK**	**F. ARM**	**THIGH**	**L. LEG**	**FEET**	**DERMAL**	**HAND**	**DOSAGE**[c]	
PHED Surface Area, cm^2	*1,300*	*260*	*2,910*	*3,550*	*3,550*	*1,210*	*3,820*	*2,380*	*1,310*	*20,290*	*820*	*Hand*	*Dermal*
Human Flaggers													
EC (aerial)	11.3	2.4	3.9	5.1	5.1	1.8	4.0	2.4	1.2	37.2	6.0	15.6	98.0
dermal dose (µg/cm^2)	**9.4**	**10.0**	**1.5**	**1.6**	**1.6**	**1.6**	**1.1**	**1.1**	**1.0**	**2.0**	**7.9**		
WSB (aerial)	11.3	2.4	3.9	5.1	5.1	1.8	4.0	2.4	1.2	37.2	6.0	140.0	872.0
dermal dose (µg/cm^2)	**83.8**	**89.0**	**12.9**	**13.8**	**13.8**	**14.3**	**10.1**	**9.7**	**9.2**	**17.7**	**70.5**		
WSB Mixer/Loader/Applicators													
Low pressure	2,636.0	907.7	494.7	700.4	611.8	448.2	5,126.3	459.0	238.7	11,622.8	34,300.0	18.5	63.5
dermal dose (µg/cm^2)	**4.6**	**7.9**	**0.4**	**0.4**	**0.4**	**0.8**	**3.0**	**0.4**	**0.4**	**1.3**	**9.3**		
High pressure	335.3	1,186.8	1,000.3	1,220.3	1,220.3	415.9	614.7	383.0	199.2	6,575.8	3,390.0	9.5	180.0
dermal dose (µg/cm^2)	**2.9**	**51.4**	**3.9**	**3.9**	**3.9**	**3.9**	**1.8**	**1.8**	**1.7**	**3.7**	**4.8**		
Backpack	345.3	1,341.8	10,116.5	275.4	8,918.2	153.6	597.3	425.9	221.5	22,395.5	96.8	0.1	146.4
dermal dose (µg/cm^2)	**0.7**	**13.9**	**9.4**	**0.2**	**6.8**	**0.3**	**0.4**	**0.5**	**0.5**	**3.0**	**0.03**		

[a] based on Table 9; listed right above each of the calculated dermal doses (i.e., above each of those in bold) is the dermal exposure rate (µg/lb active ingredient handled) from PHED subsets attached in Appendix III (namely III-F, III-H, and III-I).

[b] as an example for calculation of dermal dose: dermal dose (feet, WSB low pressure) = [(238.7 µg/lb x $(11,623 \text{ µg/lb})^{-1}$, portion of dermal exposure rate attributed to feet) x (63.5 µg/kg BW/day, dermal absorbed dosage) x $(17\% \text{ dermal absorption})^{-1}$ x (70 kg BW)] x $(1,310 \text{ cm}^2, \text{surface area for feet})^{-1}$ = 0.41 µg/cm^2, where BW = body weight; U. Arm = upper arm; F. Arm = forearm; L. Leg = lower leg; EC = emulsifiable concentrate; WSB = water-soluble bag; note that the portion of dermal exposure rate attributed to feet is based on PHED subset in Appendix III-G (i.e., the 238.7 µg/lb is from the FEET column and the 11,623 µg/lb is from the DERMAL column in this table, both for WSB low pressure); *see* Appendix VI for further detail on algorithm and assumptions used.

[c] the acute dosages for *hand* and *dermal* in the last two columns are in µg/kg BW/day (as shown in Table 9) based on a dermal absorption of 17% and after taking the appropriate multipliers into account.

Table 13. Dermal Doses ($\mu g/cm^2$) for Localized Skin Effects of Propargite, from *Subchronic* Exposures of Applicators[a,b]

Formulation/Method[a]	**HEAD**	**NECK**	**U. ARM**	**CHEST**	**BACK**	**F. ARM**	**THIGH**	**L. LEG**	**FEET**	**DERMAL**	**HAND**	**DOSAGE**[c]	
PHED Surface Area, cm^2	*1,300*	*260*	*2,910*	*3,550*	*3,550*	*1,210*	*3,820*	*2,380*	*1,310*	*20,290*	*820*	*Hand*	*Dermal*
EC aerial	4.2	0.7	8.6	6.3	8.7	2.8	9.6	7.4	3.8	52.1	96.3	126.4	68.4
dermal dose ($\mu g/cm^2$)	**1.7**	**1.5**	**1.6**	**1.0**	**1.3**	**1.2**	**1.4**	**1.7**	**1.6**	**1.4**	**63.5**		
EC airblast	778.6	65.0	42.4	21.8	14.7	7.5	56.8	17.3	9.0	1,013.1	645.0	35.2	55.2
dermal dose ($\mu g/cm^2$)	**13.4**	**5.6**	**0.3**	**0.1**	**0.1**	**0.1**	**0.3**	**0.2**	**0.2**	**1.1**	**17.7**		
EC groundboom	2.8	2.6	1.7	1.8	3.0	2.7	3.1	2.1	1.1	20.9	45.6	2.7	1.2
dermal dose ($\mu g/cm^2$)	**0.1**	**0.2**	**0.01**	**0.01**	**0.02**	**0.1**	**0.02**	**0.02**	**0.02**	**0.02**	**1.4**		
WSB aerial	4.2	0.7	8.6	6.3	8.7	2.8	9.6	7.4	3.8	52.1	96.3	1,122.6	608.6
dermal dose ($\mu g/cm^2$)	**15.5**	**12.9**	**14.2**	**8.5**	**11.8**	**11.1**	**12.1**	**14.9**	**14.1**	**12.4**	**563.7**		
WSB airblast	778.6	65.0	42.4	21.8	14.7	7.5	56.8	17.3	9.0	1,013.1	645.0	376.0	588.6
dermal dose ($\mu g/cm^2$)	**143.3**	**59.8**	**3.5**	**1.5**	**1.0**	**1.5**	**3.6**	**1.7**	**1.6**	**11.9**	**188.8**		
WSB groundboom	2.8	2.6	1.7	1.8	3.0	2.7	3.1	2.1	1.1	20.9	45.6	32.1	14.7
dermal dose ($\mu g/cm^2$)	**0.6**	**2.9**	**0.2**	**0.1**	**0.2**	**0.6**	**0.2**	**0.3**	**0.2**	**0.3**	**16.1**		

[a] based on Table 7; listed right above each of the calculated dermal doses (i.e., above each of those in bold) is the dermal exposure rate (μg/lb active ingredient handled) from PHED subsets attached in Appendix III (namely III-A, III-B, and III-C).

[b] as an example for calculation of dermal dose: dermal dose (chest, WSB groundboom) = [(1.8 μg/lb x (20.9 μg/lb)$^{-1}$, portion of dermal exposure rate attributed to chest) x (14.7 μg/kg BW/day, dermal absorbed dosage) x (17% dermal absorption)$^{-1}$ x (70 kg BW)] x (3,550 cm^2, surface area for chest)$^{-1}$ = 0.15 μg/cm^2, where BW = body weight; U. Arm = upper arm; F. Arm = forearm; L. Leg = lower leg; EC = emulsifiable concentrate; WSB = water soluble bag; note that the portion of dermal exposure rate attributed to chest is based on PHED subset in Appendix III-C (i.e., the 1.8 μg/lb is from the CHEST column and the 20.9 μg/lb is from the DERMAL column in this table, both for WSB groundboom); s*ee* Appendix VI for further detail on algorithm and assumptions used.

[c] acute dosages for *hand* and *dermal* in the last two columns are in μg/kg BW/day (as shown in Table 7), based on a dermal absorption of 17% and after taking the appropriate multipliers into account.

Table 14. Dermal Doses (µg/cm^2) for Localized Skin Effects of Propargite, from *Subchronic* Exposures of Mixer/Loaders[a,b]

Formulation/Method[a]	**HEAD**	**NECK**	**U. ARM**	**CHEST**	**BACK**	**F. ARM**	**THIGH**	**L. LEG**	**FEET**	**DERMAL**	**HAND**	**DOSAGE**[c]	
PHED Surface Area, cm^2	*1,300*	*260*	*2,910*	*3,550*	*3,550*	*1,210*	*3,820*	*2,380*	*1,310*	*20,290*	*820*	*Hand*	*Dermal*
EC aerial	128.0	38.6	157.7	19.0	10.9	4.4	16.6	37.8	19.7	432.7	45.6	19.1	4.7
dermal dose (µg/cm^2)	**0.4**	**0.7**	**0.2**	**0.02**	**0.01**	**0.02**	**0.02**	**0.1**	**0.1**	**0.1**	**9.6**		
EC airblast	128.0	38.6	157.7	19.0	10.9	4.4	16.6	37.8	19.7	432.7	45.6	6.4	1.6
dermal dose (µg/cm^2)	**0.15**	**0.2**	**0.08**	**0.008**	**0.005**	**0.006**	**0.007**	**0.02**	**0.02**	**0.03**	**3.2**		
EC groundboom	128.0	38.6	157.7	19.0	10.9	4.4	16.6	37.8	19.7	432.7	45.6	3.5	0.8
dermal dose (µg/cm^2)	**0.08**	**0.1**	**0.05**	**0.003**	**0.003**	**0.002**	**0.004**	**0.01**	**0.01**	**0.02**	**1.8**		
WSB aerial	3.5	0.7	2.6	1.8	1.8	1.1	4.9	1.2	0.6	18.2	0.6	0.7	213.3
dermal dose (µg/cm^2)	**13.0**	**13.0**	**4.3**	**2.4**	**2.4**	**4.4**	**6.2**	**2.4**	**2.3**	**4.3**	**0.4**		
WSB airblast	3.5	0.7	2.6	1.8	1.8	1.1	4.9	1.2	0.6	18.2	0.6	0.3	85.3
dermal dose (µg/cm^2)	**5.2**	**5.2**	**1.7**	**1.0**	**1.0**	**1.8**	**2.5**	**1.0**	**0.9**	**1.7**	**0.2**		
WSB groundboom	3.5	0.7	2.6	1.8	1.8	1.1	4.9	1.2	0.6	18.2	0.6	0.16	51.6
dermal dose (µg/cm^2)	**3.2**	**3.2**	**1.0**	**0.6**	**0.6**	**1.0**	**1.4**	**0.6**	**0.6**	**1.0**	**0.08**		

[a] based on Table 8; listed right above each of the calculated dermal doses (i.e., above each of those in bold) is the dermal exposure rate (µg/lb active ingredient handled) from PHED subsets attached in Appendix III (namely III-D and III-E).

[b] as an example for calculation of dermal dose: dermal dose (thigh, WSB aerial) = [(4.9 µg/lb x (18.2 µg/lb)$^{-1}$, portion of dermal exposure rate attributed to thigh) x (213.4 µg/kg BW/day, dermal absorbed dosage) x (17% dermal absorption)$^{-1}$ x (70 kg BW)] x (3,820 cm^2, surface area for thigh)$^{-1}$ = 6.2 µg/cm^2, where BW = body weight; U. Arm = upper arm; F. Arm = forearm; L. Leg = lower leg; EC = emulsifiable concentrate; WSB = water soluble bag; note that the portion of dermal exposure rate attributed to thigh is based on PHED subset in Appendix III-E (i.e., the 4.9 µg/lb is from the THIGH column and the 18.2 µg/lb is from the DERMAL column in this table, both for WSB aerial); *see* Appendix VI for further detail on algorithm and assumptions used.

[c] acute dosages for *hand* and *dermal* in the last two columns are in µg/kg BW/day (as shown in Table 8), based on a dermal absorption of 17% and after taking the appropriate multipliers into account.

Table 15. Dermal Doses (µg/cm^2) for Localized Skin Effects of Propargite, from *Subchronic* Exposures of Human Flaggers and Mixer/Loader/Applicators[a,b]

Formulation/Method[a]	HEAD	NECK	U. ARM	CHEST	BACK	F. ARM	THIGH	L. LEG	FEET	DERMAL	HAND	DOSAGE[c]	
PHED Surface Area, cm^2	*1,300*	*260*	*2,910*	*3,550*	*3,550*	*1,210*	*3,820*	*2,380*	*1,310*	*20,290*	*820*	*Hand*	*Dermal*
Human Flaggers													
EC (aerial)	11.3	2.4	3.9	5.1	5.1	1.8	4.0	2.4	1.2	37.2	6.0	3.9	24.5
dermal dose (µg/cm^2)	**2.4**	**2.5**	**0.4**	**0.4**	**0.4**	**0.4**	**0.3**	**0.3**	**0.3**	**0.5**	**2.0**		
WSB (aerial)	11.3	2.4	3.9	5.1	5.1	1.8	4.0	2.4	1.2	37.2	6.0	35.0	218.0
dermal dose (µg/cm^2)	**20.9**	**22.2**	**3.2**	**3.5**	**3.5**	**3.6**	**2.5**	**2.4**	**2.3**	**4.4**	**17.6**		
WSB Mixer/Loader/Applicators													
Low pressure	2,636.0	907.7	494.7	700.4	611.8	448.2	5,126.3	459.0	238.7	11,622.8	34,300.0	3.7	12.7
dermal dose (µg/cm^2)	**0.9**	**1.6**	**0.1**	**0.1**	**0.1**	**0.2**	**0.6**	**0.1**	**0.1**	**0.3**	**1.9**		
High pressure	335.3	1,186.8	1,000.3	1,220.3	1,220.3	415.9	614.7	383.0	199.2	6,575.8	3,390.0	3.8	72.0
dermal dose (µg/cm^2)	**1.2**	**20.6**	**1.5**	**1.5**	**1.5**	**1.5**	**0.7**	**0.7**	**0.7**	**1.5**	**1.9**		
Backpack	345.3	1,341.8	10,116.5	275.4	8,918.2	153.6	597.3	425.9	221.5	22,395.5	96.8	0.02	48.8
dermal dose (µg/cm^2)	**0.2**	**4.6**	**3.1**	**0.1**	**2.3**	**0.1**	**0.1**	**0.2**	**0.2**	**1.0**	**0.01**		

[a] based on Table 9; listed right above each of the calculated dermal doses (i.e., above each of those in bold) is the dermal exposure rate (µg/lb active ingredient handled) from PHED subsets attached in Appendix III (namely III-F, III-H, and III-I).

[b] as an example for calculation of dermal dose: dermal dose (feet, WSB low pressure) = [(238.7 µg/lb x (11,623 µg/lb)$^{-1}$, portion of dermal exposure rate attributed to feet) x (12.7 µg/kg BW/day, dermal dosage) x (17% dermal absorption)$^{-1}$ x (70 kg BW)] x (1,310 cm^2, surface area for feet)$^{-1}$ = 0.08 µg/cm^2, where BW = body weight; U. Arm = upper arm; F. Arm = forearm; L. Leg = lower leg; EC = emulsifiable concentrate; WSB = water-soluble bag; note that the portion of dermal exposure rate attributed to feet is based on PHED subset in Appendix III-G (i.e., the 238.7 µg/lb is from the FEET column and the 11,623 µg/lb is from the DERMAL column in this table, both for WSB low pressure); s*ee* Appendix VI for further detail on algorithm and assumptions used.

[c] acute dosages for *hand* and *dermal* in the last two columns are in µg/kg BW/day (as shown in Table 9), based on a dermal absorption of 17% and after taking the appropriate multipliers into account.

time fieldworkers with normal work clothes should perform their reentry tasks in a treated field is immediately following the REI (or PHI where more applicable)

In the present reentry exposure assessment, the default for *average* reentry interval was approximated as REI+3 days, based on the conservative assumption that much of the reentry activity takes place almost daily and almost always during the *first week* following the REI. That is, fieldworkers are presumed to be most active with their work at REI, REI+1, . . ., REI+6 days. Note that because foliar residues can start dissipating immediately (day 0) after application, here the earliest reentry time is counted as REI, not REI+1 days. For example, if the REI is 24 hours post-application, one must assume that the field reentry legally can take place immediately (e.g., 1 second) after 24 hours, at which time the DFR level should be determined as at day 1 post-application (or at REI = 24 hours), not REI+1 days.

Propargite is a compound having a very low vapor pressure (4.5 x 10^{-8} mm Hg, as listed in Subsection II-1). The inhalation component thus was not included in this reentry exposure assessment as it was considered negligible compared to the dermal component. This is especially the case when the REI (or PHI) is long enough to settle the airborne residues from application, which typically is not more than a few hours for a nonvolatile compound. As indicated in all the representative reentry scenarios in Table I-C of Appendix I, which for facilitation of presentation is reproduced below as Table 16, the shortest practical REI for propargite is 7 days (for cotton/corn scouting and for field-grown rose harvesting).

In addition to the resultant estimates calculated for acute and seasonal exposures, the dermal TR values, the statistics for foliar dissipation, the REI or PHI, and the assumptions used for calculating the reentry (dermal) exposures to propargite are summarized in Table 16 by crop group.

Below is a brief discussion of the data and assumptions used for calculation of the dermal fieldworker reentry exposure by crop group. *Note that unless noted otherwise, all of the DFR data considered here are summarized in Appendix II.* Also note that except for three places, the interim guidance (Frank, 2009) for WHS is to use the default values set forth in the U.S. EPA (2000b) policy for all TR used in this reentry exposure assessment. As to be elaborated on later, the three exceptions are those for *tree fruit thinners*, *tree fruit harvesters*, and *cotton scouts*.

A. Corn Harvesters/Detasselers

The PHI for sweet corn is 30 days by product labels, which is much longer than the REI of 7 days specified for *other* reentry activities performed in a corn field (Title 3, *CCR*, Section 6772). The average corn harvester reentry interval for intermediate- or long-term exposure therefore was defaulted to 33 (= PHI+3) days (hereon post-application), based on the conservative assumption stated in the preceding subsection. According to the product labels, propargite can be applied to sweet corn only once a year. No chemical-specific DFR data were available for sweet corn. As reflected in Appendix II, the only DFR study on corn was for seed corn (Polakoff, 1989a). The DFR data from that study were considered as an adequate surrogate for sweet corn in part due to the rather long half-life of foliar residues involved. Caution must be made, however, for use of the data when the PHI is not applicable

Table 16. Practical Representative Reentry Scenarios

Reentry Scenario	*Earliest Reentry Days*[a]	*Scope of Representation*
Corn harvesters	*30 (PHI)*	harvesting corn by hand
Corn detasselers	7	detasseling corn by hand
Cotton/corn scouts	7	not for scouting other crops[b]
Grape cane turners/girdlers	30	turning canes and girdling for all grape types
Grape harvesters/other cultivators	30	including all other related activities
Nectarine harvesters	21	harvesting by hand
Nectarine pruners/leaf thinners	21	including cherries[c] and all other related activities
Citrus pruners/leaf thinners	42	for oranges and grapefruit during post-harvest
Rose harvesters	3(7)	Harvesting/cutting field-grown (for aerial spray)
Jojoba harvesters	21	harvesting by hand
Christmas tree transplanters	21	including conifers for plantation
Strawberry transplanters	10	transplanting non-bearing strawberries
Dry bean harvesters	21	mechanical harvesting
Almond harvesters	28	(mechanical) floor shaking and sweeping
Walnut harvesters	21	(mechanical) floor shaking and sweeping
Potato/peanut harvesters	21	mechanical harvesting
Alfalfa/clover seed harvesters	21	mechanical harvesting
Grain sorghum harvesters	21	mechanical harvesting
Irrigators/other cultivators	21	including all not mentioned above in this table[d,e]

[a] since last application; based on the PHI (pre-harvest interval) or the REI (restricted entry interval) specified on product labels, or on the REI specified in Title 3, *California Code of Regulations*, Section 6772, or on the REI specified on the Special Local Need labels, whichever is the practical longest that is in force.

[b] for scouting other crops, use the low-contact reentry activities assumed here for other (non-grape) cultivators as surrogates instead, since the REI for scouting corn is 7 days and for other crops is 21 days; the Comite label does specify an REI of 13 days for sweet corn but a somewhat higher DFR level (hence an REI of 7 days) is warranted due to the uncertainty with lack of crop-specific DFR data (*see* Subsection V-2.B in text).

[c] cherries are allowed to be treated during the post-harvest period only; nectarine pruners/leaf thinners are used as surrogates for cherry pruners/leaf thinners for lack of more appropriate DFR data (*see* Subsection V-2.E).

[d] for all crops regardless of differences in REI, since data on a crop with very high DFR and a very slow foliar dissipation rate were conservatively used to calculate the reentry exposure for this worker group; also, the daily exposure for irrigators was assumed to be 8 hours long considering that their irrigating work typically lasts only a few hours on most any day (*see*, e.g., Edmiston *et al*., 1999).

[e] including all those other presumably low-contact activities listed in Table I-B but not mentioned in this table, such as transplanting all allowed non-bearing plants other than small Christmas tree and conifer stocks and non-bearing strawberries; that is, essentially for all low-contact activities with a dermal transfer rate TR around 1,500 µg/hr per µg/cm^2 of DFR or lower; for this worker group, data on a crop with very high DFR and a very slow foliar dissipation rate were conservatively used to calculate the reentry exposure.

and the REI is much shorter than 30 days, as the initial deposition from that study was atypically low at the application rate of 2.46 lb AI/acre. As per interim guidance at WHS, the TR of 17,000 µg/hr of dermal residues per µg/cm^2 of DFR (hereon the same units applied and for simplicity, not mentioned again) adopted by U.S. EPA (2000b) was used to estimate the reentry exposure for corn detasseling or harvesting by hand. Note that corn detasseling is a hand activity in which the pollen-producing tassel is removed from a “female” corn in order to allow hybridization of two different varieties of corn (by the tassel of a nearby “male” corn). Insofar as this hand activity includes finding the tassel, grabbing it, and pulling it off to the ground, it should be treated as having the same magnitude of reentry exposure as corn harvesting by hand would, and thereby with the same TR of 17,000. However, like for all other non-harvesting tasks in corn fields, the REI for corn detasseling is 7 days. Therefore, the dermal exposure for this reentry task was calculated according to the DFR values set for corn scouts (*see* next subsection) but using the TR for corn harvesting.

B. Cotton/Corn Scouts

Only one DFR study on premature cotton (Polakoff, 1990) was available. This study was conducted with propargite applied at the maximum label rate and with DFR measured after the maximum three applications were made. The dissipation statistics listed in Table 17 were hence used as is without adjustment for application rate. The REI for scouting in a cotton field is 7 days (*see* Table 16). The *average* reentry interval for intermediate- or long-term exposure hence was defaulted to 10 days (i.e., REI+3 days).

The dermal TR of 2,000 was used as per WHS guidance (Frank, 2009). According to the product labels including that for SLN (CA-820083) use, propargite must be applied to cotton prior to boll opening or at least 50 days prior to harvest. Note that the default, while used in previous WHS assessments for other pesticides as well (e.g., Dong, 1999; Dong and Haskell, 2000), is somewhat higher than the value (1,500) used by U.S. EPA (2000b).

As indicated in Table 16, the dermal reentry exposure estimated for cotton scouts was also intended as a surrogate for scouts working in a corn field, in part because the REI for both worker groups are 7 days (Title 3, *CCR*, Section 6772), except for *sweet* corn which has a label-specified REI of 13 days. Even for calculating the exposure for workers scouting sweet corn, an REI of 7 days was used here instead because the use of a higher DFR level (and hence a shorter REI) was warranted to avoid the potential for underestimating the reentry exposure from using the surrogate data.

On the other hand, although during certain times of the year there might be more foliage to be contacted by scouts working in corn fields than in cotton fields, the DFR used for calculating the reentry exposure for cotton scouts was based on a buildup following two applications of propargite to cotton (and thus should be considered sufficient for corn scouts). As pointed out in the preceding subsection on corn harvesters, propargite can be applied to corn only *once* a year. That subsection also cautioned the use of the DFR data presented in the seed corn study when the reentry for corn cultivators is much shorter than 30 days.

C. Grape Cane Turners/Girdlers

The most appropriate chemical-specific DFR study available on grapes (Jones, 1989) was performed with propargite applied at the maximum label rate and with DFR measured after the maximum two applications were made. It was thus considered unnecessary to make any adjustment for the dissipation statistics listed in Table 17. The REI in California is 30 days for all reentry activities in a vineyard (Table 16). The average reentry interval hence was defaulted to 33 days (i.e., to REI+3 days).

Table 17. Dissipation of Dislodgeable Foliar Residues (DFR) and Dermal Exposure to Propargite by Reentry Activity

Reentry Activity/Scenario[a]	Initial Deposition (µg/cm^2)[b]	Dissipation Rate (µg/cm^2/day)[b]	Transfer Rate (µg/hr per µg/cm^2)[c]	REI (days)[d]	DFR (REI)[e]	DFR (REI+3 Days)[f]	Acute Dermal (µg/kg/day)[g]	Seasonal Dermal (µg/kg/day)[h]
Corn harvesters	0.96	-0.0231	17,000	*30*[d]	0.19	0.17	378.2	322.4
Corn detasselers[i]	1.70	-0.0453	17,000	7	0.82	0.60	1,591.4	1,163.8
Cotton/corn scouts[j]	1.70	-0.0453	2,000	7	0.82	0.60	140.4	102.7
Grape cane turners/girdlers	1.66	-0.0316	10,000	30	0.19	0.15	213.8	172.0
Grape harvesters/other cultivators	1.66	-0.0316	5,000	30	0.19	0.15	106.9	86.0
Nectarine harvesters	5.36	-0.0287	1,500	21	1.34	1.10	229.4	188.1
Nectarine pruners/leaf thinners	5.36	-0.0287	3,000	21	1.34	1.10	458.8	376.3
Citrus pruners/leaf thinners	3.32	-0.0101	3,000	42	1.25	1.16	428.6	399.7
Rose harvesters/cutters	7.00	-0.0640	7,000	7	2.50	1.60	1,999.5	1,285.1
Jojoba harvesters	3.75	-0.0192	2,000	21	1.49	1.30	338.7	296.7
Christmas tree/conifer transplanters	1.46	-0.0334	1,000	21	0.29	0.23	33.2	26.3
Strawberry transplanters	1.46	-0.0334	1,000	10	0.68	0.54	77.7	61.4
Dry bean harvesters	3.90	-0.0486	2,500	21	0.37	0.27	106.3	76.0
Almond harvesters/	4.14	-0.0276	1,500	28	0.70	0.58	119.7	99.0
Walnut harvesters	4.14	-0.0276	1,500	21	1.09	0.90	186.8	154.4
Potato/peanut mechanical harvesters	4.14	-0.0276	1,500	21	1.09	0.90	186.8	154.4
Alfalfa/clover seed mechanical harvesters	4.14	-0.0276	1,500	21	1.09	0.90	186.8	154.4
Grain sorghum mechanical harvesters	4.14	-0.0276	1,500	21	1.09	0.90	186.8	154.4
Irrigator and other cultivators	4.14	-0.0276	1,500	21	1.09	0.90	186.8	154.4

[a] the scope of representation for each of the reentry activities listed in this table is summarized in Table 16 (and Table I-C of Appendix I) and further discussed in Subsection V-2.

[b] DFR projected at day 0 post-application and their dissipation rate, as summarized in Table II-A of Appendix II, after adjustment for maximum rate and number of reapplications involved as discussed in Subsection V-2.

[c] value for the task-specific dermal transfer rate TR (µg/hr dermal residues per µg/cm^2 of DFR) was discussed in Subsection V-2, including data source and the assumptions made.

[d] from Table 16; these restricted entry intervals (REI), for simplicity also including preharvest interval (PHI), were *for reentry exposure assessment purposes* actually based on the *longest* of the REI specified in Title 3, *California Code of Regulations*, Section 6772, the REI on the Special Local Need labels, or the REI or PHI on the product label, *where applicable and in force*; note that all values listed in this column are REI except the one PHI of 30 days for corn harvesters.

[e] projected from the log-linear regression $\log_{10}[DFR_t] = \log_{10}[DFR_0] + (-k)t$, as discussed briefly in Subsection V-2 and more extensively in Appendix II (where DFR_0 is the initial deposition, $-k$ is the foliar dissipation rate, and time t is the REI, or PHI where appropriate, in this assessment but otherwise is any time post-application).

[f] projected as described in footnote *e*, except that time t is at REI+3 (or PHI+3, where appropriate) days as a conservative estimate for average reentry interval (as discussed in Subsection V-2).

[g] calculated from the algorithm *acute dermal* = $[(DFR_t) \times (TR) \times (8 \text{ hours/day}) \times (70 \text{ kg average body weight for male and female adults, Thongsinthusak } et\ al., 1993 \text{ and U.S. EPA, } 1997)^{-1}]$, where DFR_t was projected from the regression equation in footnote *e* and the 8-hour workday was for all fieldworkers except for cotton/corn scouts noted in footnote *j*.

[h] calculated in the same manner as in footnote *g*, except with DFR_t at time t = REI+3 (or PHI+3) days as a conservative estimate for average reentry interval (as discussed in Subsection V-2).

[i] using the foliar dissipation statistics for cotton/corn scouts as surrogates (*see* Subsections V-2.A and V-2.B for further discussion) and based on a workday of 8 hours (instead of 6 hours as for cotton/corn scouts).

[j] based on 6 hours as assumed in previous assessments (*e.g*., Dong, 1994; Dong and Haskell, 2000), by excluding 2 hours known to be typically for traveling from field to field.

As per WHS guidance (Frank, 2009), the standard value of 10,000 listed in the U.S. EPA's policy was used here as the dermal TR for grape cane turners and girdlers.

D. Grape Harvesters and Other Grape Cultivators

Per WHS guidance (Frank, 2009), the TR value of 5,000 listed in the U.S. EPA's policy was used for grape harvesters and other grape cultivators not involved in cane turning or girdling. Note that this default is somewhat lower than the value (7,500) determined and used in the previous reentry exposure assessment by WHS for naled (Dong and Haskell, 2000). Because the REI remains the same (30 days), the average reentry interval hence was also defaulted to 33 days as for grape cane turners and girdlers.

E. Nectarine Harvesters/Pruners/Thinners

The REI for nectarines is 21 days (Table 16), with a one-time reapplication interval of 21 days. The average reentry interval thus was defaulted to 24 days. The only DFR trial (as reflected in Appendix II) on nectarines (Siemer, 1988) was conducted with foliar samples taken *post*-harvest. The dissipation data from that trial were hence not used, based on the argument that the initial deposition and the DFR for other days could have been distorted (lowered) by recent previous reentry activity made. The DFR data on *peaches* (Siemer, 1988) as listed in Appendix II were thus used instead. Of the two peach trials, data from the one with the higher correlation of determination $R^2 = 0.99$ (Figure II-I in Appendix II) were used for nectarine harvesters. Foliar samples in that peach trial were taken after a single application at 2.25 lb AI/acre. The projected initial deposition was increased proportionally from 3.33 to 4.29 $\mu g/cm^2$, to account for the maximum label rate of 2.8 lb AI/acre allowed for nectarines. At the day after the reapplication interval, the DFR on nectarines would be ~1.07 $\mu g/cm^2$ = antilog $\{\log_{10}[4.29] + (-0.0287) \times (21 \text{ days})\}$, where 0.0287 is the dissipation rate listed in Table 17. That is, the projected initial deposition on nectarines after a maximum *second* application would be ~5.36 $\mu g/cm^2$ [= (1.07 $\mu g/cm^2$ left from the first spray) + (4.29 $\mu g/cm^2$ from the second spray made immediately after the reapplication interval)].

The TR values for nectarine (or stone fruit) harvesters and pruners/thinners were assumed to be 1,500 and 3,000, respectively. These are the other two of the three exceptions noted earlier per WHS guidance (Frank, 2009), as well as the defaults that U.S. EPA updated (Dawson, 2003) after it released its policy memorandum (U.S. EPA, 2000b) on TR values.

The Omite-30WS label allows cherries to be treated during the post-harvest period. For lack of more appropriate DFR data, nectarine pruners/leaf thinners were used as surrogates for cherry pruners/leaf thinners. The DFR for nectarines were considered to be sufficient for cherries in that the maximum label rate for the former crop is 1.5 times higher than that for the latter. Both crops can be treated twice per season at a minimum spray interval of 21 days and with the same REI of 21 days (Title 3, *CCR*, Section 6672).

F. Citrus (Orange and Grapefruit) Pruners/Thinners

The REI for oranges and other citrus is 42 days (Table 16), with no reapplication allowed. The average reentry interval hence was defaulted to 45 days. The dissipation rates were similar among the three field trials (Appendix II) conducted on oranges (Siemer, 1989). In the present reentry exposure assessment, the foliar data from the trial with the highest R^2

(Figure II-L in Appendix II) was used for oranges and other citrus. Foliar samples in that orange trial were taken following a single application at 4.5 lb AI/acre, with a projected initial deposition of 4.45 μg/cm^2. The current maximum label rate allowed for application to oranges is 3.36 lb AI/acre. Therefore, the projected initial deposition for this maximum label rate was reduced proportionally from 4.45 to 3.32 μg/cm^2.

The dermal TR for citrus (orange) harvesters was assumed to be 3,000, as used for fruit tree pruners and leaf thinners in general. As explained earlier for nectarines, this TR was updated by U.S. EPA (Dawson, 2003).

G. Rose Harvesters/Other Flower Cutters

The DFR study used for field-grown roses was conducted by Fong *et al*. (1990), in which foliar samples were taken after a single application at 1.5 lb AI/acre (Appendix II). The REI for field-grown roses (by ground application) in California is supposed to be 3 days, as specified in Title 3, *CCR*, Section 6772. Yet the SLN label sets the REI at 7 days for aerial sprays while not specifying any reapplication interval or the total number of sprays allowed per season. The SLN-based REI was thus used here as it would yield a higher DFR (due to no limitation on reapplication); and the average reentry interval hence was defaulted to 10 days. Based on the dissipation statistics shown in Table 17, the buildup of DFR with over four consecutive sprays is considered immaterial. Accordingly, the initial deposition was projected from *four* sprays to be 6.5 μg/cm^2 = [4.24 μg/cm^2 (at day 0, from fourth spray) + 1.51 μg/cm^2 (at day 7 post-third spray) + 0.54 μg/cm^2 (at day 14 post-second spray) + 0.19 μg/cm^2 (at day 21 post-first spray)]. As can be seen from the above calculation, the residuals from the *oldest* of *five* consecutive sprays would be far below 0.19 μg/cm^2, which compared to the estimated initial deposition (6.5 μg/cm^2, based on 4 sprays) is immaterial. Since the maximum label rate allowed for field-grown roses is 1.6 lb AI/acre, the projected initial deposition was increased (and rounded up for beyond the fourth spray) from 6.5 to 7.0 μg/cm^2.

No dermal TR value is given in the U.S. EPA policy specifically for field-grown roses. The TR used here for cutting field-grown roses was assumed to be 7,000, as used in the U.S. EPA (2000b) policy and elsewhere (Dong, 1999; Dong and Haskell, 2000) for flower cutters and stockers in general. This TR from U.S. EPA was considered more than sufficient in that it represented the average of those observed by Brouwer *et al*. (1992) for *greenhouse* workers cutting *carnations* sprayed with chlorothalonil and thiophanate-methyl. Their average, based on two sides of leaf surface as common practice, was around 6,500 (i.e., average of 14.4 mg/hr residues on hands and forearms [i.e., up to elbow length] per 5.0 μg/cm^2 chlorothalonil on *one* side of leaf surface], and 16.1 mg/hr residues on hands and forearms per 4.5 μg/cm^2 thiophanate-methyl on *one* side of leaf surface). The roundup to 7,000 was a reasonable approach to account for the small unmeasured amount from body parts other than the hands and forearms. This surrogate TR was used under the assumption that the hand contact should not be any less from cutting off carnations and collecting them into a bundle on the arm, than cutting and collecting most other flowers including field-grown roses.

H. Jojoba Harvesters

No foliar residue studies are available for jojoba. Data from one field study on hops were used to represent the DFR on jojoba as the best surrogate available. This study has not been submitted to DPR for review, but was described by U.S. EPA (Tadayon, 2000) in their RED for propargite. The dissipation statistics listed in Table 17 were based on foliar samples taken after the maximum two applications were made each at 1.35 lb AI/acre. Because the maximum label rate for jojoba is 1.64 lb AI/acre, the projected initial deposition from the hop study was increased proportionally from 3.09 to 3.75 $\mu g/cm^2$. As the REI is 21 days, the average reentry interval was defaulted to 24 days. Here in line with the default adopted by U.S. EPA (2000b), 2,000 was used as the dermal TR value for jojoba harvesters.

I. Christmas Tree/Conifer Transplanters

There are no DFR studies of propargite on conifers. As summarized in Appendix II, two DFR trials were conducted on *fruit*-bearing strawberries (Polakoff, 1989b). These DFR data were intended as surrogates for transplanting *non*-bearing strawberries and other nursery stock (e.g., ornamentals, small Christmas trees), considering that the activity of transplanting fruit-bearing strawberries is deemed as the best surrogate available for transplanting non-bearing strawberries and nursery stock. The REI for nursery stock in general is 21 days, with a maximum of 3 sprays per year and a reapplication interval ranging from 14 days (for most nursery stock) to 28 days (for small Christmas trees). The average reentry interval hence was defaulted to 24 days.

As a realistic worst-case scenario, the DFR data from the trial with the lower dissipation rate (Figure II-P in Appendix II) were used to project foliar dissipation on nursery stock and non-bearing strawberries. Foliar samples in that trial (and in the other as well) were taken after 3 sprays at 7-day intervals, *much sooner* than the shortest allowed minimum reapplication interval of 14 days. The projected initial deposition from that trial, based on 1.5 lb AI/acre, was thus used as is without adjustment even for those nursery crops with higher label rates (e.g., 2.4 lb AI/acre for small Christmas trees with a reapplication interval of 28 days, and 1.92 lb AI/acre for non-bearing strawberries with a reapplication interval of 21 days).

The dermal TR for this worker group was assumed to be 1,000, based on the general observation that the activity involved is not as dermal contact intensive as picking tomatoes or similar activities (*see*, e.g., U.S. EPA, 2000b). At the time of this assessment, U.S. EPA has not yet provided a definite value specifically for this type of reentry activity.

J. Strawberry Transplanters

For fieldworkers transplanting non-bearing strawberries in California, the REI on the product labels is specifically 10 days, thus yielding a default average reentry interval of 13 days. The dermal TR for this worker group was also assumed to be 1,000, for the same reasons given above for Christmas tree/conifer transplanters. The same projected initial deposition from the trial for Christmas tree/conifer transplanters was also used here even though the maximum application rate (1.92 lb AI/acre) for non-bearing strawberries is somewhat higher. Again, this is because the DFR data from that trial (Polakoff, 1989b) were taken after 3 sprays at 7-day intervals, whereas only 1 application per season is allowed for strawberries.

K. Dry Bean Harvesters

For dry beans, the REI is 21 days. The average reentry interval hence was defaulted to 24 days. DFR data from one foliar residues study on dry beans (Gaydosh, 1990) were available. Foliar samples in that DFR study were taken after the maximum second application at the maximum allowable rate. Therefore, no adjustment on the projected initial deposition was deemed necessary. The dermal TR of 2,500 was used for fieldworkers hand harvesting this type of vegetables, which is the default adopted by U.S. EPA (2000b).

L. Irrigators/Other Cultivators Engaging in Low-Contact Activities

Although propargite can be used on almonds, walnuts, alfalfa seed, clover seed, grain sorghum, potatoes, peanuts, field corn, and cotton, these other crops/sites typically do not involve *hand* harvesting or any moderate- to high-dermal contact activities. Reentry exposures for these crops/sites are thus more of a concern with irrigators, nut harvesters, and other fieldworkers not yet covered in this reentry exposure assessment.

The DFR statistics in Table 17 suggested that data from the study on almonds (Kludas, 1991) might serve as a reasonable conservative surrogate for the other crops/sites not included earlier in this section. In that almond study, foliar samples were taken after two applications, which is the maximum number of applications allowed per year for these other crops considered here. The minimum reapplication interval is 21 days for almonds and for many of these other crops not yet covered in this section. The REI is 21 days for these other crops (Title 3, *CCR*, Section 6672), except for almonds. The average reentry interval hence was defaulted to 24 days for all these other crops except for almonds. For almonds, the REI is specifically set at 28 days (per label specification). The average reentry interval for almond harvesters hence was specifically defaulted to 31 days.

The dermal TR was assumed to be 1,500 for irrigators (i.e., irrigation workers) and for workers performing these other low-dermal contact activities. This TR default is comparable to that used in most cases by U.S. EPA (2000b) for similar low-contact activities (e.g., nut harvesting, hand weeding, staking, training, pruning non-bearing trees). Note that while this type of cultivation activity may be somewhat labor intensive, the actual dermal contact is minimal especially when the worker wears gloves. Most of these activities take place when the plants are still short or young with less foliage for dermal contact. Another fact is that these reentry activities can be performed easily prior to pesticide application.

Furthermore, generally irrigators have their hands in contact with only a small section of an irrigation pipe. Even when their lower (clothed) body comes in contact with a treated crop while searching for or picking up the pipe, the dermal contact is not expected to be as intensive as the contact a cotton scout would experience, especially to the hands.

Nut harvesting is expected to generate dust. However, studies (e.g., Maddy *et al*., 1985) showed that both inhalation and hand exposures to pesticides (e.g., diazinon, propargite, azinphos-methyl) from nut harvesting are minimal. This is expected since the most recent pesticide application prior to harvesting is generally three or four weeks earlier. In the case with propargite, the REI for almonds and walnuts are 28 and 21 days, respectively.

The reentry exposure calculated for the other (non-grape) cultivators was also considered to be a good surrogate for scouting crops other than cotton or corn. For the other crops (except strawberries and field-grown roses), the REI is 21 days or longer per state regulation (Title 3, *CCR*, Section 6672). Another reason is that the dermal contact for scouting these other crops is much less compared to what cotton or corn scouts may experience. Sometimes scouts are required to walk through fields packed with fully-grown cotton or corn, but much less so when working with other crops. In fact, for some crops including strawberries and field-grown roses, scouting can be accomplished by visual inspection with little dermal contact with the treated foliage.

M. Short- and Long-Term Exposures

The ADD estimates from short-term, intermediate-term (i.e., subchronic), and long-term reentry exposures to propargite are summarized in Table 18. In addition to the DFR predicted at the appropriate reentry interval, the calculation of long-term reentry exposure needs to take into account the number of days that fieldworkers are exposed each year. Much like those for long-term handler exposures, these reentry exposure frequency numbers are needed for annualizing chronic dosage. The algorithm used to determine the annual exposure frequency for fieldworkers is described briefly in the subsection below but more extensively in Appendix V.

N. Exposure Frequency

To estimate long-term exposures for fieldworkers, temporal patterns in propargite use were investigated, following a similar logic to that previously used to estimate the long-term exposures for handlers. A major difference was involved here, though, between the investigation for handlers (Appendix IV) and that for fieldworkers (Appendix V). For field-workers, the monthly usage was based on *acres* treated, not pounds of AI handled. Here the focus was on acreage because reentry frequency for fieldworkers depends more on the size of the crop treated. As determined in Appendix V and reflected in Table 18 (fifth column), the PUR data support a range from 2 to 6 months as the reasonable conservative annual exposure frequencies for reentry activities involved in the various sites considered, with citrus having the lowest and corn having the highest. Note that this frequency range was determined for annulization purposes. Otherwise, as determined in Appendix V, the numbers of highest-use months ranged from 2 to 5, with corn having the highest (Table 18).

O. Dermal Concentrations on Fieldworkers

As for handlers (Subsection V-2.I), there was a requirement for calculating the dermal concentrations for the fieldworkers considered in this exposure assessment in that propargite is known for its skin irritation potential.

The dermal concentrations calculated for *acute* and *subchronic* exposures of the various representative fieldworker groups to propargite are listed in Tables 19 and 20, respectively, along with footnotes indicating the basic algorithm and assumptions used. Note that the unabsorbed dermal doses calculated for subchronic exposures of the various fieldworker groups can also be used for their chronic exposures. However, chronic dermal doses were not amortized in the present reentry exposure assessment because skin irritation type localized effects are rarely caused by long-term exposure. As for handler exposures, further elaboration on the use of the algorithm and assumptions for reentry exposures was deferred to Appendix VI.

Table 18. Estimates of Absorbed Daily Dosages (ADD, in µg/kg/day) for Reentry Exposure to Propargite

Reentry Activity/Scenario[a]	Acute Dermal (µg/kg/day)[b]	Seasonal Dermal (µg/kg/day)[b]	No. of High-Use Months[c]	No. of Months for Annualization[c]	Acute ADD[d]	Seasonal ADD (SADD)[e]	Annual ADD (AADD)[f]	Lifetime ADD (LADD)[g]
Corn harvesters	378.2	322.4	5	6	64.3	54.8	27.4	14.6
Corn detasselers	1,591.4	1,163.8	5	6	270.5	197.9	99.0	52.8
Corn (cotton) scouts	140.4	102.7	5(3)	6(4)	23.9	17.5	8.8 (5.8)[h]	4.7 (3.1)[h]
Grape cane turners/girdlers	213.8	172.0	4	4	36.4	29.2	9.7	5.2
Grape harvesters/other cultivators	106.9	86.0	4	4	18.2	14.6	4.9	2.6
Nectarine harvesters	229.4	188.1	3	4	39.0	32.0	10.7	5.7
Nectarine pruners/leaf thinners	458.8	376.3	3	4	78.0	64.0	21.3	11.4
Citrus pruners/leaf thinners	428.6	399.7	2	2	72.9	67.9	11.3	6.0
Rose harvesters/cutters	1,999.5	1,285.1	4	5	339.9	218.4	91.0	48.5
Jojoba harvesters	338.7	296.7	3	3	57.6	50.5	12.6	6.7
Christmas tree/conifer transplanters	33.2	26.3	4	5	5.6	4.5	1.9	1.0
Strawberry transplanters	77.7	61.4	4	5	13.2	10.5	4.4	2.3
Dry bean harvesters	106.3	76.0	3	4	18.1	12.9	4.3	2.3
Almond harvesters/mech. harvesters	119.7	99.0	3	5	20.4	16.8	7.0	3.7
Walnut harvesters/mech. harvesters	186.8	154.4	3	5	31.8	26.3	11.0	5.8
Potato/peanut mech. harvesters	186.8	154.4	3	5	31.8	26.3	11.0	5.8
Alfalfa/clover seed mech. harvesters	186.8	154.4	3	5	31.8	26.3	11.0	5.8
Grain sorghum mech. harvesters	186.8	154.4	3	5	31.8	26.3	11.0	5.8
Irrigator and other cultivators[a]	186.8	154.4	3	5	31.8	26.3	11.0	5.8

[a] the scope of representation for each of the reentry activities listed in this table is summarized in Table 16 and further discussed in Subsection V-2 of this document; in this table other cultivators include those very low-contact reentry activity not listed in this table but mentioned in Table I-B in Appendix II and in Table 16.

[b] from Table 17, based on the algorithm *dermal (unabsorbed) exposure* = [(DRF_t) x (TR) x (hours in a workday) x (average body weight for male and female adults)$^{-1}$, where DFR_t is the dislodgeable foliar residues at time t post-application and TR is the task-specific hourly dermal transfer rate.

[c] from Appendix V, also as briefly discussed in Subsection V-2.N.

[d] from acute dermal exposure in column 2, after multiplying by the dermal absorption of 17% for propargite (Subsection III-2).

[e] from seasonal dermal exposure in column 3, after multiplying by the dermal absorption of 17% for propargite (Subsection III-2).

[f] AADD = SADD x [(number of months for annualization, as listed in the fifth column)/12 months in a year)].

[g] LADD = AADD x (40 years of work in a lifetime/75 years in a lifetime).

[h] in parentheses is the dosage for *cotton* scouts, as the number of months used for amortization was 4 for these fieldworkers.

Table 19. Dermal Doses ($\mu g/cm^2$) for Localized Skin Effects of Propargite, from *Acute* Reentry Exposures[a,b]

Formulation/Method	**HEAD**	**NECK**	**U. ARM**	**CHEST**	**BACK**	**THIGH**	**L. LEG**	**FEET**	**DERMAL**	**HAND**[a]	**DOSAGE**[c]
Estimated Surface Area, cm^2	*1,108*	*222*	*2,481*	*3,027*	*3,027*	*3,257*	*2,029*	*1,117*	*16,269*	*1,731*	*($\mu g/kg$ BW/day)*
Corn harvesters	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	13.0	64.3
Corn detasselers	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	54.7	270.5
Cotton/corn scouts	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	23.9
Grape cane turners/girdlers	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.8	36.4
Grape harvesters/other cultivators[a]	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	3.7	18.2
Nectarine harvesters	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	7.9	39.0
Nectarine pruners/leaf thinners	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	15.8	78.0
Citrus pruners/leaf thinners	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	14.7	72.9
Rose harvesters/cutters	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	68.7	339.9
Jojoba harvesters	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	11.6	57.6
Christmas tree/conifer transplanters	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	1.1	5.6
Strawberry transplanters	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	2.7	13.2
Dry Bean harvesters	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	3.7	18.1
Almond harvesters/mech. harvesters	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	4.1	20.4
Walnut harvesters/mech. harvesters	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	6.4	31.8
Potato/peanut mech. harvesters	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	6.4	31.8
Alfalfa/clover seed mech. harvesters	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	6.4	31.8
Grain sorghum mech. harvesters	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	6.4	31.8
Irrigator and other cultivators	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	6.4	31.8

[a] as an example for calculation of dermal dose: dermal dose (chest of grape harvesters) = [($3{,}027\ cm^2$)/($16{,}269\ cm^2$) x 15% of (18.2 $\mu g/kg$ BW/day, total dermal absorbed dosage) x (17% dermal absorption)$^{-1}$ x (70 kg BW)]/($3{,}027\ cm^2$) = 0.07 $\mu g/cm^2$, where BW = body weight; U. Arm = upper arm; L. Leg = lower leg; the hand (699 cm^2) exposures above included forearm (1,032 cm^2) and were assumed to contribute to roughly 85% of the total whole body dermal, *except for cotton/corn scouts and grape girdlers for which all body parts including the hand and forearm were assumed to contribute equally*; *see* Appendix VI for further detail on algorithm and assumptions used.

[b] the surface areas for various body regions were scaled down proportionally from those based on total male body surface area of 21,110 cm^2 (*see*, e.g., Table 10) to the default total female body surface area of 18,000 cm^2 (*see* first part in Appendix VI for further discussion).

[c] *acute* dosages (for *whole body dermal including hand/forearm*) in the last column are those given in Table 18, and based on a dermal absorption of 17% per Subsection III-2.

Table 20. Dermal Doses (μg/cm^2) for Localized Skin Effects of Propargite, from *Subchronic* Reentry Exposures[a,b]

Formulation/Method	**HEAD**	**NECK**	**U. ARM**	**CHEST**	**BACK**	**THIGH**	**L. LEG**	**FEET**	**DERMAL**	**HAND[a]**	**DOSAGE[c]**
Estimated Surface Area, cm^2	*1,108*	*222*	*2,481*	*3,027*	*3,027*	*3,257*	*2,029*	*1,117*	*16,269*	*1,731*	*(μg/kg BW/day)*
Corn harvesters	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	11.1	54.8
Corn detasselers	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.8	40.0	197.9
Cotton/corn scouts	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	17.5
Grape cane turners/girdlers	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	29.2
Grape harvesters/other cultivators[a]	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	3.0	14.6
Nectarine harvesters	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	6.5	32.0
Nectarine pruners/leaf thinners	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	12.9	64.0
Citrus pruners/leaf thinners	0.4	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	13.7	67.9
Rose harvesters/cutters	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.8	44.2	218.4
Jojoba harvesters	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	10.2	50.5
Christmas tree/conifer transplanters	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.9	4.5
Strawberry transplanters	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04	2.1	10.5
Dry bean harvesters	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	2.6	12.9
Almond harvesters/mech. harvesters	0.06	0.06	0.06	0.06	0.06	0.06	0.06	0.06	0.06	3.4	16.8
Walnut harvesters/mech. harvesters	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	5.3	26.3
Potato/peanut mech. harvesters	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	5.3	26.3
Alfalfa/clover mech. harvesters	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	5.3	26.3
Grain sorghum mech. harvesters	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	5.3	26.3
Irrigator and other cultivators	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	5.3	26.3

[a] as an example for calculation of dermal dose: dermal dose (chest of grape harvesters) = [(3,027 cm^2)/(16,269 cm^2) x 15% of (14.6 μg/kg BW/day, total dermal absorbed dosage) x (17% dermal absorption)$^{-1}$ x (70 kg BW)]/(3,027 cm^2) = 0.06 μg/cm^2, where BW = body weight; U. Arm = upper arm; L. Leg = lower leg; the hand (699 cm^2) exposures above included forearm (1,032 cm^2) and were assumed to contribute to roughly 85% of the total whole body dermal, *except for cotton/corn scouts and grape girdlers for which all body parts including the hand and forearm were assumed to contribute equally*; *see* Appendix VI for further detail on algorithm and assumptions used.

[b] the surface areas for various body regions were scaled down proportionally from those based on total male body surface area of 21,110 cm^2 (*see*, e.g., Table 10) to the default total female body surface area of 18,000 cm^2 (*see* first part in Appendix VI for further discussion).

[c] *subchronic* dosages (for *whole body dermal including hand/forearm*) in the last column are those given in Table 18, and based on a dermal absorption of 17% per Subsection III-2.

3. Exposure from Non-Agricultural Settings

Propargite is not registered for use in residential or other public settings. Exposure to drift is expected to be minimal and transient, if any, in that the product labels specifically advise against any application in a way that would let people come in contact with this *nonvolatile* miticide directly or through drift. However, there may still be some concerns regarding the exposures of residents located close enough to the application sites and the exposures of other bystanders working in adjacent fields. In short, there may be the potential that these residents or bystanders could encounter propargite residues at air levels similar to or greater than those that propargite handlers in the fields would encounter.

A. Exposure of Bystanders to Offsite Air

As stated in Subsections IV-1, the California Air Resources Board (ARB, 2000) conducted a study in which air levels of propargite were monitored very close to a field in Fresno County, California, where in July 1999 the miticide was sprayed on 12 acres of grapes using ground spray rigs. In that summer, ambient air concentrations were also monitored for propargite to coincide with its peak use on cotton and grapes in the county.

For ambient air monitoring, seven sampling sites were selected from areas of Fresno County where cotton and grape farming occurred and in populated areas or in areas frequented by people. Except for the site located at a school district bus barn, the other six sampling sites were located on or by school buildings. In addition, urban samples were collected at the ARB air monitoring station in Fresno for use as controls. The air samplers were all placed at 8 to 39 feet above ground. A total of 176 ambient samples (excluding spikes, blanks, and the lower of collocated samples) were collected over a six-week period from June 24 through August 3, 1999. The results of the 176 ambient samples are summarized in Table 21, which is essentially a reproduction of the summary table given in the ARB study report. There was no mention in the ARB study report whether or not the results as presented had been adjusted for any laboratory, trip, or field spike recoveries. Nonetheless, such an adjustment was not considered necessary given that the recoveries averaged 95 to 106% (as any such adjustment will be inconsequential when the recovery is close to 100%).

Table 21. Summary of Propargite Ambient Monitoring Results (ng/m^3)[a,b]

	ALV	ARB	HEB	HUR	KBB	KHS	SES	SJE
Maximum	1,300	25	110	Det	65	79	Det	46
Average	170	13	23	10	42	43	5	10
No. of Samples	22	22	22	22	21	22	21	21
No. > EQL	22	3	6	0	20	17	0	2
No. of Det	0	14	10	14	1	2	4	9
No. < MDL	0	5	6	8	0	3	17	11

[a] from 24-hour air samples taken in Fresno County, California, during summer of 1999 (ARB, 2000); ALV = Alvina Elementary School; ARB = ARB air monitoring station; HES = Helm Elementary School; HUR = Huron Elementary School; KBB = Kingsburg School District Bus Barn; KHS = Kerman High School; SES = Stratford Elementary School; SJE = San Joaquin Elementary School.

[b] MDL (method detection limit) = 16.7 ng per sample; Det (detected) = value below the estimated quantitation limit (EQL) of 83.5 ng/sample but >MDL.

For application (offsite) air monitoring, one air sampler was placed at each of the four sides of the 12-acre field, with a fifth sampler collocated (duplicated as well as positioned side by side) at the east position. All five samplers were positioned within 42 feet outside of the edge of the field. The monitoring period lasted nearly four days from July 13 (11:15 AM) to July 17 (7:10 AM), including the first 24 hours devoted entirely for collection of the background samples. The rest of the air samples were collected at five intervals following a ground-spray application (at 1.92 lb propargite AI per acre) which took place on July 14 from 8:20 PM to 9:35 PM. (Note that this 75-minute long application did not start until 9 hours after collection of all the background samples; more specifically, the sampling period for application air lasted 2.5 days, or 58.75 hours from July 14 around 9:35 PM through July 17 around 7:10 AM.) The results of these application air samples are summarized in Table 22, which is essentially a reproduction of the summary table given in the ARB study report.

Table 22. Summary of Propargite Offsite (Application) Monitoring Results (ng/m^3)[a,b]

Sampling Period	Hours Sampled	East Collocated	East	North	West	South
Background	24	NA	6.1E+01	6.9E+01	1.1E+02	NA
1	1¼ (1½)	3.4E+03	2.9E+03	<MDL	5.3E+02	3.5E+03
2	9 ½	3.7E+02	4.2E+02	2.9E+02	2.4E+02	2.8E+02
3	12¼	1.1E+03	NA	2.7E+02	1.8E+02	4.7E+02
4	11¾	3.7E+02	3.6E+02	1.3E+02	1.1E+02	2.4E+02
5	24	NA	4.0E+02	1.0E+02	9.2E+01	NA

[a] propargite was sprayed in July 1999, at 1.92 lb AI (active ingredient) per acre to a 12-acre vineyard located in Fresno County, California (ARB, 2000); note that the first offsite (non-background) sampling period was treated as having lasted about 90 (*vs.* 75) minutes long to err on the side of public health protection since the first 15 min (or more) from the second sampling period could still have an air level as high as those observed during the first, shorter sampling period.

[b] MDL (method detection limit) = 16.7 ng per sample; NA = not applicable.

As stated in the ARB study report, one problem encountered in analyzing the offsite air samples is that the average recovery for the field spikes was only 50%, although those for the trip and laboratory spikes were 105% and 106%, respectively. Again, there was no mention whether or not the results as reported had been adjusted for field spike recovery. As ARB (2000) subtracted background levels before calculating field spike recoveries, they argued that the recoveries were actually higher than the estimated 50%. Furthermore, as noted by ARB, laboratory and travel spikes were 106% and 105%, respectively, and field spikes associated with the ambient air monitoring averaged 95 to 106%. This evidence suggests that the 50% mean spike recovery in the application site monitoring was an artifact of the background correction, and offsite sample results were hence not corrected here for field spike recoveries. ARB (2000) pointed out that for any field spike recovery determination to be valid, the spike level used should be at least several times *greater* than the background level. Otherwise, the inherent variability or error of measurements on the much higher background level could easily mask, overshadow, or otherwise obscure the actual recovery of the much lower level of spike added to the background. Yet in this ARB study, the (unspiked) offsite background (air) levels were expected to be much greater than the (unspiked) ambient (air) levels due to the fact that an application was made recently and adjacent to the offsite sampling sites. Accordingly, when compared to the ambient levels, the background levels would have a greater impact on the determination of field spike recoveries, especially if substantially lower field spikes were unknowingly used in as well as for the recovery analysis.

The offsite air data presented in Table 22 can be easily as well as readily converted to the *absorbed inhalation dosages* (AIhDs) in question by using the commonly-used algorithm: AIhD = [(air concentration) x (inhalation rate) x (inhalation absorption) x (body weight)$^{-1}$]. This algorithm was used accordingly in the present inhalation exposure assessment. The conversion results are summarized in Table 23.

Table 23. Absorbed Inhalation Dosages (μg/kg/day) Estimated for Bystanders to Propargite Offsite (near the Application Site)[a]

	ADD – 1 Hour[b]	ADD – 24 Hours[c]	SADD[d]	AADD[e]
Infants	0.219	1.361	0.590	0.197
Adults	0.105	0.646	0.280	0.093

[a] based on the commonly-used algorithm: absorbed inhalation dosage = [(air level) x (inhalation absorption) x (inhalation rate) x (body weight)$^{-1}$; here the default inhalation absorption of 100% was used; also, as in accordance with the interim defaults set forth and used by the Department (Andrews and Patterson, 2000; Lewis, 2004), the 1- and 24-hour inhalation rates for infants used were 0.025 and 0.59 m^3 per kg of body weight (respectively), and for adults, 0.012 and 0.28 m^3/kg (respectively); here infants were defined as less than 1 year old and used to represent as the worst case for all children, as they have the highest default rate among all children when body weight is considered.

[b] ADD = absorbed daily dosage; based on the 90-minute air concentration of 8.75 μg/m^3 (i.e., from the highest concentration of 3.5 μg/m^3 observed at the south site as presented in Table 22), after adjustment for maximum application rate from 1.92 lb/acre to 4.8 lb/acre.

[c] based on the first 23-hour weighted air concentration of 2.31 μg/m^3 calculated from concentrations measured at the east collocation site during the first three non-background sampling periods (i.e., those second to fourth presented in Table 22) and adjusted for maximum application rate (from 1.92 lb/acre to 4.8 lb/acre).

[d] SADD = seasonal/subchronic (i.e., intermediate-term, between 8 days and 3 months) ADD; based on the average air level of 1.0 μg/m^3 approximated in Subsection V-3.B with the offsite air data listed in Table 22, and after thorough and due consideration of the loglinear regressions depicted in Figure 1 (which nonetheless due to lack of sufficient data points failed to provide any conclusive direction).

[e] AADD (annualized ADD) = SADD x (number of months for amortization/12 months in a year); here the number of months used was 4, as used for calculating all the handler and most reentry exposures in Subsections V-1 and V-2; note that for adults (but not for infants or children, as soon would outgrow their age range), their LADD (lifetime ADD) was *assumed* to be the same as their AADD for lack of data on lifetime exposure frequency/duration.

<u>*B. Average Air Concentration for Bystanders*</u>

Note that the above effort of calculating the AIhDs was not attempted without statistical challenge. Apparently there were no air data on propargite monitored *offsite* for any period longer than 2.5 days post-application, either from the ARB study or elsewhere, to offer a long-term average air level of propargite for bystanders. This type of air data is needed in order to estimate the *long-term* inhalation exposure of bystanders to propargite. One approach is to use the ambient air concentrations provided in Table 21. However, *in general* such a practice is likely to underestimate the chronic or subchronic inhalation exposure at issue, especially to highly volatile pesticides, in that potentially those people living adjacent to application sites, even on average, could be exposed to higher concentrations of airborne (propargite) residues than those residing farther away from the application sites.

Another approach is to use the highest 24-hour air concentration observed from the offsite air data on hand, such as the highest first 24-hour air level of 2.31 $\mu g/m^3$ reflected in Table 22 (i.e., after adjustment for maximum application rate, as specified in footnote *c* in that table). However, as discussed below, such use of the offsite air data could yield some unrealistically high estimates for the *average* dosages for infants and children even at near a worksite.

Still another approach is to "approximate" a more reasonable average air level for long-term exposure by extrapolation or projection from samples measured for a short monitoring period (e.g., those presented in Table 22). This approximation approach, for lack of a better term, is thought to provide a bit more realistic average air level and hence is currently being used by WHS assessors. For this approach, the approximation method is supposed to rely heavily on the performance of log-linear regression(s) with the air data on hand, following much of the concepts and assumptions presented in Appendix II for approximating the dissipation of DFR (dislodgeable foliar residues). A key uncertainty in estimates calculated with this approach stems from limited information about the extent to which reapplications occur.

The approximation approach was attempted in this subsection accordingly using two closely-related log-linear regressions performed with the air data given in Table 22. The results of the attempts are graphically characterized in Figure 1. As can be seen in the figure, Regression 1 differs from Regression 2 only in the latter excluding from the analysis all the air levels monitored *during* the (first) 90-minute long propargite application period.

Regression 2 was additionally performed because there appeared to be a rather abrupt drop of air levels following the first ~90 minutes post-application, suggesting that the airborne residues would dissipate almost completely within one week's time if reapplication is not an issue (e.g., if it does not take place). Although this might well be the case, it could not be readily supported by the limited data on hand. A closer look at the data would find that the air levels tended to fluctuate within the range of 100 to 400 ng/m^3 during the period between 2 to 59 hours post-application. More importantly, any *re*application to be made very close to the same field within one or two weeks time would easily bring the air levels back up to the 300 or 400 ng/m^3 region. (Regression 2 in Figure 1 shows that the airborne residues would dissipate almost completely within two weeks post-application, again if no reapplication is made.) Furthermore, as shown in Figure 1, the correlation coefficient *r* from either regression (i.e., either 0.66 or 0.45) was regarded as less than acceptable by most standards. Therefore, it would seem pointless to fine tune the regression(s) here, such as by using another form of regression or another subset of the air data on hand, until there is available meaningful information that can be used to ascertain the reapplication potential at issue.

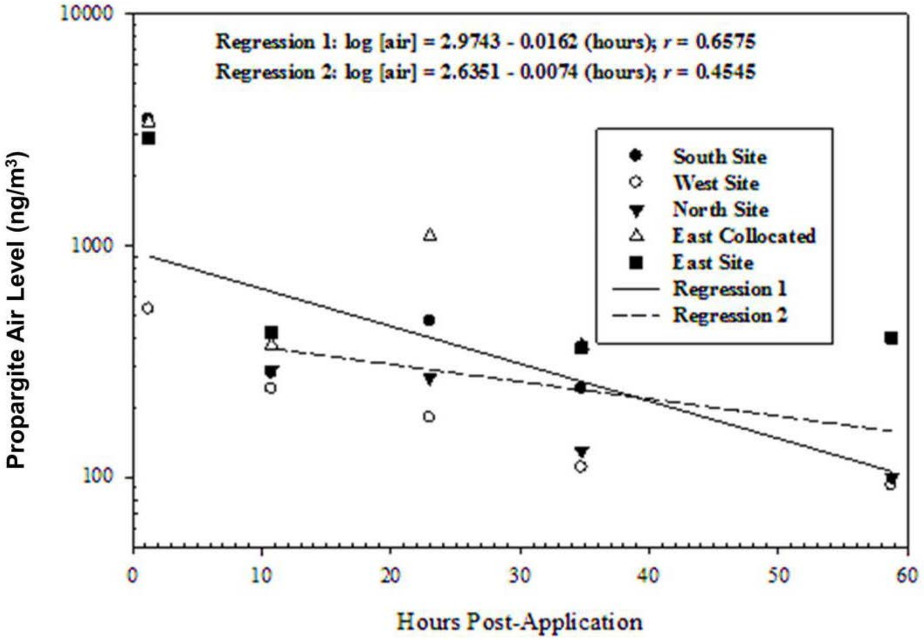


Figure 1. Dissipation of Airborne Propargite Residues around Site of Ground Spray (at 1.92 lb AI/acre) to a 12-Acre Vineyard in Fresno, California, July 1999 (from Data Presented in Table 22)

Certain speculation can be made about the *minimum reapplication* interval at stake here, however. According to the propargite product labels, for all crops the minimum reapplication interval is 14 days and the maximum number of applications per crop per season is 3. Such label requirements ensure that any propargite reapplication to the *same* field sooner than 2 weeks is prohibited. However, there is still a small possibility that propargite could be applied shortly (e.g., within 1 week) to a field (or a section) *adjacent* to the one just sprayed. At the same time, it is unlikely that any reapplication to adjacent areas would take place any sooner than 3 or 4 days unless the area just sprayed is so huge that it would warrant a full workday to complete the spray operation there. In other words, it is not efficient or practical for growers to spend two or more days to spray a place that can be done easily in one day.

It is also unlikely for the number of reapplications to *adjacent* fields to be greater than 3, as this is the maximum number of applications per crop per season. Still one further argument is that there is rarely any home situated in the center with all its four sides fenced with crop fields to be treated with the same pesticide repeatedly around the same time. In short, the potential for any buildup of airborne propargite residues due to reapplication is slim.

Figure 1 essentially offers a quick and an easy visual support of the impracticality, if not the impossibility, that bystanders would be exposed over multiple hours or days to such a high air level as *8.75 $\mu g/m^3$* (as footnoted in Table 22, after adjustment to maximum label rate of 4.8 lb AI/acre). The air data on hand supported the assertion that *during* a ground spray application, the airborne propargite residues settle very rapidly (likely within an hour, as can be seen in Table 22 by comparing the air data collected between the first and the second non-background sampling period). This means that unless a bystander is *deliberately* staying right next to the field *during* a spray, he or she will be exposed to a much lower air concentration during that short time interval (by roughly an order of magnitude, again *see* data in Table 22 or Figure 1). Note that even when a spray application were to last 8 hours (e.g., for some 60 acres of crop or more), instead of some 1.25 hours as in the ARB study for 12 acres of grape vineyard, in real life bystanders would not stay too close to "an application spot" *throughout the entire 8 hours*, unless they deliberately and continuously "chase" the spraying around by running over to the side of a large field closest to where the spray operation actually takes place.

Following the logic explained above, an air level of 1,000 ng/m^3 was assumed as the upper-bound average for short-term (i.e., ≤7 days) inhalation exposure of bystanders to propargite. This air concentration (1,000 ng/m^3) was based on the assumption that, unless there are sufficient air data to support a (statistical) dissipation trend, the "upper-bound average" is defaulted to the highest air level observed among samples or replicates measured at the latest time of a short monitoring period. In this case, Table 22 shows that the highest air concentration measured at 59 (58.75) hours post-application was 400 ng/m^3, which was elevated to *1,000 ng/m^3* after adjustment for maximum rate allowed (i.e., from 1.92 lb AI/acre in the ARB study to 4.8 lb AI/acre).

C. Exposure of Local Residents to Ambient Air

It also should be pointed out that even though the estimation here was supposed to be as inclusive and comprehensive as possible, the estimates of inhalation dosages for *ambient air* exposure are deliberately excluded in Table 23 to avoid confusion. The ambient air data were characterized and discussed throughout this subsection as a reference only, or for use to compare with those air data for bystander exposure only. Typically, to err on the side of public health protection, the default practice is to employ the higher (or the highest) of two (or of all) available average air levels for calculating long-term inhalation exposures of people residing in an affected community, provided that the chosen average is a *reasonably realistic concentration*.

In most instances, the average extrapolated from the *offsite* air data measured, even for a short monitoring period, would be greater than the highest average level observed for *ambient* air, and hence should be used, particularly when the active ingredient of concern is a volatile chemical and/or is allowed to be reapplied to the same crop repeatedly within a short interval. When a pesticide is *volatile*, its residues have the tendency to come off the treated foliage or soil into the atmosphere much more easily and at much higher intensity.

In contrast, all residues of a *nonvolatile* pesticide would tend to stay on the treated foliage or any treated surface, and would settle onto the ground quickly even if they somehow got dislodged (knocked) off . For this reason, and because airborne concentrations become more diluted as distance from an application increases, the average ambient air level of a *nonvolatile* pesticide is lower than concentrations encountered by (or extrapolated for) bystanders located around offsite areas.

A subtle reservation for the above argument is the slight possibility that the sampling sites for ambient air could all be situated in the *large central area* inside a district surrounded by fields to be treated with the nonvolatile chemical, whereas the application site selected for an air monitoring study is typically located in one small spot of all the fields surrounding such a large central area. In other words, this large central area can be exposed constantly to some air residues, in however small amounts, coming from many more fields which, located however far away from the "hot spot", are collectively treated much more constantly throughout a season. On the contrary, residents living near an application site under study *might* be exposed to the air residues coming from a very limited direction at a relatively very small spot (e.g., northwest side *near the border* of a county) treated a couple of times only. In fact, their homes as well as the application site under study could happen to be situated *upwind* of the spray during the time when the short monitoring period took place.

As propargite is a nonvolatile chemical, it was deemed necessary to contrast the average air level that can be extrapolated from Figure 1, with that derived from the ambient air data (inasmuch as the latter happened to be available). The data here show that for propargite, the highest average concentration of 170 ng/m^3 from the ambient air data (Table 21) was well within the range of air concentrations (100 - 400 ng/m^3) observed in the offsite data (as presented in Table 22, except those collected within some 90 minutes post-application).

VI. EXPOSURE APPRAISAL

1. Use of Defaults and Surrogate Data

Handler Exposure. PHED has a considerable number of limitations as a surrogate database. It combines measurements from worker exposure studies conducted using different protocols, different analytical methods, and different residue detection limits. Most dermal exposure studies in PHED used the patch dosimetry method of Durham and Wolfe (1962), which requires residues measured on small patches placed on different regions of the body to be extrapolated to estimate exposure to that region. In some of these studies, patches were placed on only a few body regions, such as only the hands, arms, head, and face. And the estimates of dermal exposure for various body regions may be based on different sets of replicates. For some scenarios, the number of matching observations in PHED is so small that the estimate is not reliable. Due to the degree of uncertainty so inherent in the PHED data, WHS has opted to approximate the UCL (upper confidence limit) for the exposure statistics in an effort to increase the confidence in the exposure estimates used.

The limitations with PHED are more than statistical in nature. The exposure data in PHED were graded for laboratory and field sample recoveries. Grade A and grade B represent high quality data, with laboratory and field recoveries generally greater than 80 and 50%, respectively. Grade C represents moderate quality, with laboratory and field recoveries of 70 to 120% and 30 to 120%, respectively. In line with the criteria set forth by U.S. EPA (1998), the position of the WHS scientific staff is that the PHED subsets with grade A or B data and a minimum of 15 observations are deemed to provide high confidence in data quality. Those PHED subsets including grade C data are deemed to provide moderate confidence.

As shown in Appendices III-A through III-I, 5 of the 9 PHED subsets for handler exposure include grade C data. The four PHED subsets with grade B data or better are for airblast applicators, for mixer/loaders handling liquid formulations or water soluble bags, and for human flaggers guiding aerial liquid spray. Also shown in these nine appendices are five PHED subsets that each have less than 20 observations for dermal (that excluding hand) exposure, meaning that a multiplier of 5 or greater was used to generate the upper-bound dermal ADD for the five subsets. Those five subsets with fewer than 20 observations were for aerial applicators spraying liquid formulations, for mixer/loaders handling water soluble bags, and for M/L/applicators using a backpack, a high pressure, or a low pressure sprayer. Note that for consistency and transparency purposes, all the exposure rates derived from these and other (commonly-used) PHED subsets have been standardized in a WHS technical report (*see* Beauvais *et al.*, 2008).

<u>Default Usage</u>. The dose estimates for handlers were calculated under the premise that exposure is linearly proportional to the amount of pesticide handled. It is fair to say that this is unlikely the case where the amount of pesticide applied is outside a practical range. More specifically, a large amount of material used in a day's work can be handled in a number of ways, depending on how the product is packaged or formulated and what type of mixing, loading, or application equipment or method is used.

The caution for consideration of a practical range is not without merits. U.S. EPA (2001b) uses 350 acres per day for aerial application to lower-acre (e.g., row) crops, justifying that the estimate was based on the PHED application data normalized to an 8-hour day. Yet their daily acreage of 1,200 assumed for aerial application to high-acre crops (e.g., corn, cotton, wheat, alfalfa) was also based on an 8-hour workday. Thus, if the exposure rate were based on hours worked, instead of amount of pesticide handled, then in this case it would make no difference whether the daily acreage is 350 or 1,200 for aerial application, as daily *exposure* would be unaffected by this acreage difference. Nonetheless, despite such an argument, in general exposure rate based on amount of pesticide handled is still deemed more practical. This is because exposure rate based on work time is less reliable, as it is more difficult to monitor the actual time spent in a specific task than to monitor the amount of pesticide used.

Data from two biomonitoring studies, as summarized in Ross and Driver (2005), further support empirically the caution on practical range. In one study of *airblast* mixer/loaders (Honeycutt and DeGeare, 1994), the daily dosage was estimated as 4.7 μg/kg for the workers handling 74 lb of chlorpyrifos liquid under an open-pour system. In another study of *aerial* mixer/loaders wearing *less* PPE (Knuteson *et al.*, 1999), the daily dosage was estimated as 1.2 μg/kg for handling 400 lb (i.e., 5.4 times more) of the same pesticide liquid while using a similar type of system for mixing/loading. Accordingly, the chemical-specific exposure *rates* calculated from these two studies are *4.4 μg* [= (4.7 μg/kg)/(74 lb) x (70 kg)] and *0.21 μg* [= (1.2 μg/kg)/(400 lb) x (70 kg)] *per lb of chlorpyrifos AI handled*, respectively, for airblast and aerial mixer/loaders each having a body weight of 70 kg. It thus appears that beyond a certain range, handler exposure is not necessarily linearly proportional to the amount of pesticide handled, at least not when different types of mixing/loading equipment are used. One possible explanation for the nearly 21-fold exposure rate difference (i.e., 4.4 µg/lb handled for mixing/loading for airblast *vs.* 0.21 µg/lb handled for mixing/loading for aerial) observed between the above two studies is that, perhaps due to the larger or more advanced mixing/loading tanks employed, actually fewer loadings might have been required for the aerial spray than for the airblast (ground) application.

The defaults used for maximum daily acreage in pesticide exposure assessment thus must be treated with the above caution in mind. It was for this reason that the default was rounded and capped to 600 acres per day for aerial application, even though as many as 620 acres from a unique single application of propargite was reported (*see* Subsection V-1.A).

As stated earlier, the maximum daily acreage used for groundboom application was 100. Note that the way in which the PUR data were used earlier for aerial spray (as discussed in Subsection V-I.A) is not directly applicable for groundboom application, given that up to some 600 acres were also reported to have been covered per use number for *ground* spray. Apparently, multiple groundboom tractors were used on the same day for such a large field operation.

As often observed by the WHS field teams, each pass (spray line) for ground spray to cotton or corn is at most 36 feet wide since the booms in the center and on the left and the right side together cover 9 rows each of 3 to 4 feet wide. Each one-mile long pass thus would cover 4.4 acres of the crop. This in turn would require 23 passes to cover 100 acres. With an average tractor speed of 4 MPH, or 1 pass (mile) per 15 minutes (excluding the time for turning the tractor around for the next pass), it would require 5.75 *straight* hours (= 345 minutes = 23 passes x 15 minutes/pass) to spray 100 acres. It would also require at least 6 reloadings of the spray solution per tractor with a typical tank size of 300 to 350 gallons, since propargite should be applied at a minimum of 20 gallons per acre. Thus, even at the rate of 1 loading per 15 minutes (including the time for bringing the tractor to the reloading facility, etc.), it would take 1.5 hours to complete all 6 reloadings required for 100 acres per tractor. In short, all together each tractor would take at least 7 *straight* hours to complete 100 acres, excluding the time spent in cleaning the boom equipment after its use for the day.

Reentry Exposure. As discussed in Appendix II, dermal TR is not only an important concept but also a very critical tool for estimating reentry exposure. Therefore, it is important to note that many of the TR values used in the present reentry exposure assessment, namely those provided by U.S. EPA (2000b), have not been validated extensively. While the present exposure assessment uses TR from U.S. EPA (2000b), recently U.S. EPA has revised its TR policy (U.S. EPA, 2012). DPR is reviewing the revised policy. In some cases, exposure monitoring of field activities by WHS staff suggests different TR from those used by U.S. EPA. For example, monitoring of tree fruit harvesters yielded an overall average TR of 4,000 (Haskell, 1995), which is higher than the TR of 1,500 previously recommended by U.S. EPA (Dawson, 2003) or the TR of 1,400 now recommended in their revised policy (U.S. EPA, 2012). Those WHS data were compiled from 18 trials conducted in three California counties

(Sutter, Stanislaus, and Fresno) where hand harvesters were exposed to azinphos-methyl, phosmet, phosalone, or propargite applied to peach orchards.

Despite the limitations and uncertainties discussed above, it is fair to say that the dermal TR values used in this reentry exposure assessment (as listed in Table 17) are not expected to underestimate exposure. Supporting this assertion is the general observation (*see*, e.g., Dong and Haskell, 2000; Haskell, 1995; U.S. EPA, 2000b) that except for a few reentry tasks, the TR values derived empirically thus far have been well below 10,000. Also, it is reasonable to expect that the reentry exposures from high-contact activities (e.g., harvesting grapes or corn by hand) are several times greater than those from low-contact activities (e.g., mechanical harvesting, staking, scouting, nut harvesting, training). The DFR values used here were likewise considered to be adequate although they bear similar limitations in generalization: having been conducted under specific conditions. The DFR values used in the present exposure assessment were considered unlikely to underestimate exposure because they were projected at the expiration of the REI (the first hour that workers are allowed to reenter a field) for short-term reentry exposure, or at REI+3 days for long-term exposure.

2. Exposure Assessment by U.S. EPA

As stated in Subsection II-7 (and reflected in various places such as Tables 4 through 6), the 8 groups of *handler* exposure scenarios considered in this exposure assessment were similar to those used in the RED for propargite by U.S. EPA (2001a). The RED included only 7 handler exposure scenarios since it did not consider M/L/applicators using handheld equipment as a potential. This handler group was included in the present assessment revision based on the argument that use of propargite is not prohibited for small-scale operations. There were also other differences explaining why DPR ended up having a total of 17 *sub*scenarios for handler exposure, as summarized in the comprehensive list in Table I-A (in Appendix I), whereas the RED included a total of only 14 *sub*scenarios.

The main reason for the difference is that the EAD's 8 scenarios for handler exposure were each further subdivided according to product formulation/packaging (i.e., whether the product to be handled is an emulsifiable or a wettable powder in WSB) in order to account for the specific clothing or PPE required. The only subscenario used in the RED that the present exposure assessment did not consider was mixing/loading liquid for *chemigation*, which is not an application method allowed in California. And for each of the 14 subscenarios considered for the older set of labels (including the products not packaged in WSB and not cancelled at the time), U.S. EPA assessed the handler exposures according to the crop group(s) involved in an attempt to account for the daily usage of propargite per crop treated. DPR assessors have not followed this crop-based assessment scheme under the strong belief that an operator's *maximum* daily exposure potential is limited not by the crop treated, but by the total crop *acres* that this individual handler can physically treat in a normal workday. DPR assessors took the position that more than one handler would be hired to jointly do the same job if the acres to be treated in a day exceeds *a single* worker's physical limitation.

For fieldworkers, the various field reentry subscenarios used by U.S. EPA (2001a) were similar to those considered in the present exposure assessment, except for rose cutters. The use of propargite on *harvestable* roses in California is well reflected in Title 3, *CCR*, Section 6627, which allows an REI of 3 days for field-grown roses. In contrast, the (federal) product labels provide a specific PHI for each crop allowed for propargite treatment, with field-grown rose being one of the few exceptions (i.e., without a PHI). For most reentry subscenarios considered, the short- and long-term exposures estimated between the two agencies were mostly different because different DFR and REI values were used (despite the fact that the same dermal TR values were used for the same field reentry tasks). As noted in Appendix II, the DFR data used in the present exposure assessment were limited to those from field studies conducted in California due to consideration of use and meteorological compatibility. In addition, the log-linear regressions used by DPR for the foliar dissipation were based more specifically on the general procedures outlined for WHS (Andrews, 2000), which U.S. EPA did not follow.

3. Estimation of Annual and Lifetime Exposures

Estimates of longer-term exposures for both handlers and fieldworkers were largely based on the worker annual exposure frequency estimates derived from the Department's annual PUR data, which as mentioned earlier do not provide records for handling or reentry activities of *individual* workers. Nor do they itemize the daily activities or usage for workers or crops within a county or region. In short, the PUR data provide at best only a history of the maximum potential duration periods for pesticide exposure of a certain worker group. For one thing, it is unlikely that handlers or fieldworkers would work most every day with the *same* pesticide during any month recorded in the PUR, even if handlers or fieldworkers could be exposed to the same pesticide by working from field to field, or crop to crop. It is also based on this argument that re-investigation of the worker annual exposure frequencies is not considered necessary unless the PUR data are too outdated.

Earlier in calculating the reentry exposures, irrigators were not deliberately separated from fieldworkers performing other low-contact or miscellaneous activities. One reason for this is, again, the argument that their reentry exposures can often be estimated sufficiently using the same REI, DFR, and TR values. Another more subtle reason is that some irrigators may also be responsible for performing some of these other low-contact activities (e.g., hand weeding). It is thus more appropriate to treat them as a single group in calculating their (especially long-term) reentry exposures.

Special care also must be given when determining the high-use months (i.e., those reaching 5% of the total use) or the months that need to be included for annualizing chronic dosage. It is not realistic to include the months that simply reached the pre-determined cut-point percentage but failed to use a sufficient amount of the pesticide or to cover a sufficient amount of the crop. That is, it is simply not fair to include months reflecting mathematically a reentry or handling activity that can be completed in a few days, rather than weeks or months, by a single worker or a single crew.

4. Use of Pharmacokinetics and Toxicity Data

The dermal absorption of 17% estimated (*see* Section III-2) based on rat studies and used in this exposure assessment was considered fairly sufficient. As pointed out in Ross *et al.* (2000), a review of several compounds tested indicated that the rat overestimated human dermal absorption by two- to ten-fold. In addition, dosage is expressed as a single static value both in worker exposure and animal toxicology studies. The rates of dermal absorption and acquisition are often seen or expected to be lower than the rates of oral absorption and acquisition in animals used for toxicology testing. In short, the dose via the nonbolus dermal route is likely to be less potent than the same amount administered orally. This factor was discussed in Dong and Haskell (2000) and in Ross *et al*. (2000).

5. SLN Label Specifications

The SLN label CA-940008 was issued effective March 17, 1994, which has been allowing *aerial* application of the WSB product (i.e., Omite-30WS) on field-grown roses in California to this date. Otherwise, as per (federal) label specifications, the WSB product can be applied to field-grown roses via ground equipment only. Both the labels for aerial and for ground use specify that 2 to 5 lb of the WSB product be applied per acre. The major differences between the two labels (other than the application methods involved) are the number of reapplications allowed, the REI allowed, and the composition of propargite AI. A brief discussion of these differences is deemed necessary here as they have an impact on the assessment of reentry exposure for the field-grown rose cutters.

For ground use on (field-grown) roses, the federal label limits three sprays per year, with a reapplication interval of 14 days. In contrast, the SLN label allows as many aerial sprays as needed for seasonal control, without any specification on the reapplication interval. In the meantime, the REI from aerial spray is 7 days whereas that from ground use is 14 days. And current version of Title 3, *CCR*, Section 6627 sets the REI at 3 days for field-grown roses treated with propargite. Furthermore, inasmuch as the SLN use is supposed to be associated with the WSB label, it is interesting to note that the composition of propargite AI specified on the SLN label is 30% by weight, whereas that on the federal label is 32.0%.

To be consistent with the WHS practice tending to err on the side of worker health protection whenever in doubt, in this assessment the reentry exposure for rose cutters was calculated on the basis that the WSB product, whether for aerial or ground use, contains 32.0% of the propargite AI by weight. As discussed in Subsection V-2.G, the practical REI used was 7 days per the SLN label specifications. The reapplication interval used for the assessment was hence 7 days. It was also due to the fact that there is no limit specified for the number of aerial sprays allowed on roses, harvesting activity was so assumed and assessed accordingly.

6. Use of Geometric Mean Transfer Rates for Cotton Scouts

As stated in Subsection V-2.A and per WHS guidance (Frank, 2009), the dermal TR of 2,000 was used for cotton (and corn) scouts in this assessment. This default was actually based on the value estimated earlier by WHS (Dong, 1990) using a series of TR derived from field studies conducted by Ware *et al*. (1973, 1974, 1975). In those field studies, mature cotton was treated with monocrotophos, ethyl-parathion, or methyl-parathion. The TR estimated earlier by WHS for the whole body of cotton scouts was first approximated as the sum of the individual geometric mean TR computed from the Ware *et al*. series for the *bare* hands (950), for the *unprotected* upper body (1,020), and for the *unprotected* lower body (9,640) of male cotton scouts. Using the default clothing penetration value of 10% (Thongsinthusak *et al*., 1993), the hourly dermal TR was estimated as 2,016 for cotton scouts wearing normal work clothes *without* gloves, or approximately 2,000. Although it is comparable to the one (1,500) currently used by U.S. EPA (2000b), this geometric mean-based TR tends to overestimate the reentry exposure for scouts working in fields where cotton is not fully grown. That is, less contact with foliage is expected where a crop is not fully grown and its foliage is less dense. (Again, according to the product labels, propargite must be applied to cotton prior to boll opening or at least 50 days prior to harvest.) The somewhat lower value of 1,500 adopted by U.S. EPA (2000b) was overridden by the WHS guidance (Frank, 2009) primarily because the U.S. EPA value was based on field studies in which scouting was performed on dry beans instead of cotton, while at the same time the WHS estimate for scouting cotton was available.

The interim default adopted by WHS is deemed appropriate and sufficient despite the fact that the arithmetic mean is almost always greater than the GM for the same set of (positive) values, especially where the data follow a lognormal distribution. In this case with estimating the value for a surrogate TR, the use of a GM appears to be more suitable for two reasons.

First, only three real time field studies (Ware *et al.*, 1973, 1974, 1975) involving 9 trials were available to WHS for use to estimate a surrogate TR for cotton scouts. That third study conducted on monocrotophos in 1975 yielded TR values not only inconsistently greater than those generated from the other two studies on ethyl- and methyl-parathion, but also much greater than those commonly observed for reentry tasks of this type. Second and equally crucial, GM is often used as a measure of central tendency with the intent to discount much of the impact of the extreme value(s) in a set. In taking the GM over the arithmetic mean here, the guidance is in the position that the actual TR for cotton scouts is *likely* to be closer to those observed in the first two studies on ethyl- and methyl-parathion, than to those observed in the third study. The third study was not ignored completely, however, because in the event that the above position were proven wrong, the error would then be less substantial. In some other instances, such as when estimating a worker's average daily exposure, the use of arithmetic mean should still be warranted. This is because in that case, no matter how extreme the value is in a given set, it is still one that the same individual (or same group) would likely experience *eventually* over a long enough time period.

Mathematically, the GM for the whole (body) does not equal the sum of the GM for its individual parts. That is, $\mathrm{GM}[A+B+C] \neq \mathrm{GM}[A] + \mathrm{GM}[B] + \mathrm{GM}[C]$. Based on an earlier review (Dong, 1990) of the same three studies, the GM-based TR for cotton scouts were 950, 1,022, 9,639, and 12,405 for the bare hand, the bare upper body, the bare lower body, and the whole bare body, respectively. Clearly, the sum of the first three GM is 11,611, not exactly equal to the GM of 12,405 measured for the whole body. There was a good reason, however, to set the *potential* TR for the whole body of cotton scouts equivalent to the sum of the three individual GM. In addition to the fact that the values 11,610 and 12,405 both lead to a rounded-off TR of 12,000, in this way the mitigation effects on the whole body can be added up *directly* if certain measures are applied to any one of the three body parts.

7. Other Pathways for Residential or Bystander Exposure

It is important to note that due to certain regulatory practices and limitations, the present exposure assessment had its focus necessarily and most appropriately on exposure scenarios that address the product label uses involved. Accordingly, some minor potential pathways that are frequently considered as relevant to residential and bystander exposures were not addressed in this exposure assessment, at least not in a quantitative manner as the exposures involved could not be assessed per any label use. Exposures of this kind at best can be considered only qualitatively as follows.

First, assessment of general *dietary exposure* to propargite, or to any other pesticide, from consumption of foods and drinking water in California is the responsibility of the Medical Toxicology Branch (MedTox). MedTox is the only functional unit within DPR that currently has the appropriate programming package to perform a comprehensive routine dietary exposure assessment for pesticides used in California. In any case, MedTox has completed an RCD for propargite based on dietary exposure alone (Lewis, 2004).

As for *swimmer exposure* potential, the propargite residue levels in California surface waters were found to be low enough that they should not pose any health concern. According to a report by DPR's Environmental Monitoring Branch (Xu, 2001), 330 surface water samples were collected from January 1993 through August 1998 for analysis of propargite content in California waters. The highest propargite residue concentration found in these samples was 20 ppb (20 μg/L). Note that the annual use of propargite in California has declined considerably since the early 2000s, suggesting that the propargite residue levels in surface water in California should be much lower in recent years.

Because of such low water levels found for propargite, and the fact that the other exposure assessment documents (*see*, e.g., that for carbaryl or for simazine) have already approximated the potential exposure for swimmers in surface water, WHS is now able to conclude easily and fairly that such an exposure scenario will not merit consideration unless either the skin permeability coefficient K_p for the pesticide under assessment is greater than 0.03 cm/hr or the no-observed-effect-level (NOEL) of concern is approaching the nanograms scale. In the case with propargite, the lowest critical NOEL of concern was reportedly set at 1 mg/kg/day (Lewis, 2004). And the K_p for propargite is 0.004 cm/hr, as calculated from using a K_{ow}-based algorithm given by U.S. EPA (2004) along with the octanol-water partition coefficient (K_{ow}) value listed in Table 1 in this document.

Children's exposure to soil residues should also be considered insignificant, for at least three reasons. First, propargite is not allowed to be used in any non-agricultural setting. Second, as noted in Section IV-4, it is not expected that any significant amount of oral intake or dermal uptake of soil residues would occur even near an application site, as this is not a place where children would frequent much. Third, propargite is reportedly (moderately) persistent in soil, with half-lives ranging from 2 to 4 months (Xu, 2001); that is, it is not expected that the propargite soil residues would move off the application site easily or quickly. Furthermore, the bulk of the propargite residues in each spray are supposed to be applied onto the foliage, not the soil.

Finally, WHS exposure assessors are well aware that lately there have been concerns over children's exposure to pesticide residues brought home from agricultural workers. However, while the amounts for this type of pesticide residues are not quantifiable in relation to any specific label use, thus far they have not been reported to result in significant exposures to family members.

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VIII. APPENDICES

Appendix I
Scoping of Potential Exposure Scenarios for Propargite

A potential exposure scenario is one that describes a possible situation or a possible set of events where people may come in contact with pesticide residues, and in which both the nature and the magnitude of the exposure are relatively homogeneous. The magnitude of an exposure is most likely related to application methods, application sites, exposure duration, worker activities, product formulation, and physicochemical characteristics of the AI at issue. Scoping proposal is thus typically the initial essential step of pesticide exposure assessment, involving primarily the search for and the determination of all potential exposure scenarios subject to consideration in an exposure assessment.

An exposure assessment for propargite was performed by WHS in 1989 (Thongsinthusak *et al*., 1989) without the completion of a documented scoping proposal as it was not common practice at the time. Then a more formal scoping process for propargite was initiated in 1998 (Thongsinthusak, 1998), the year in which WHS attempted to revise the propargite exposure assessment. However, that assessment revision has not become active until much later for two reasons. First, there was a shift of pesticide exposure assessment priority due to the lack of staff resource at WHS. Yet more importantly, at that time U.S. EPA was in the midst of revising their occupational exposure assessment for propargite (Tadayon, 2000). Despite the fact that the U.S. EPA revision was completed several years ago, the one and only registrant (Crompton Corporation) at the time had at least a couple of years to respond to U.S. EPA's mitigation proposal, if any. That is, some California uses could be suspended or affected either due to U.S. EPA's mitigation actions or as a result of the registrant's response to those proposed actions. It is now necessary for WHS to perform the scoping proposal again, in that it has been many years since the initiation of its first proposal.

All considerable (i.e., pre-targeted) potential exposure scenarios from this re-scoping are summarized in Table I-A for agricultural handlers, and in Table I-B for agricultural fieldworkers. From these two relatively comprehensive lists, which were based on all current California label uses, nine (9) worker categories of potential exposure scenarios were identified for the purpose of facilitating the exposure assessment or scoping discussion. They were similar to those outlined in the initial scoping proposal, as well as to those used in U.S. EPA's RED revision. These nine worker categories are: (1) mixing/loading for airblast; (2) mixing/loading for aerial application; (3) mixing/loading for groundboom application; (4) application by airblast equipment; (5) application by aerial equipment; (6) application by groundboom equipment; (7) flagging for aerial spray; (8) mixing/loading and application by handheld equipment; and (9) reentry of fieldworkers. Exposures in residential and non-agricultural settings were not scoped, since propargite is not registered for such uses.

1. Handler Exposure

As stated above, there were 8 worker categories of potential exposure identified for handlers. When application methods were further subdivided and product formulations were also considered, a total of 17 potential scenarios for handler exposure were determined as related to propargite used in the agricultural setting. These 17 scenarios are listed in Table I-A.

Table I-A. Potential Exposure Scenarios Related to Propargite
Used in the Agricultural Setting

Formulation/Packaging	*Application Method/Equipment*	*Handler Group*
Emulsifiable[a]	aerial	applicator
	aerial	mixer/loader
	aerial	human flagger
	airblast	applicator
	airblast	mixer/loader
	groundboom	applicator
	groundboom	mixer/loader
Water Soluble Bag[b]	aerial	applicator
	aerial	mixer/loader
	aerial	human flagger
	airblast	applicator
	airblast	mixer/loader
	groundboom	applicator
	groundboom	mixer/loader
	backpack sprayer	mixer/loader/applicator
	high pressure handwand	mixer/loader/applicator
	low pressure handwand	mixer/loader/applicator

[a] emulsifiable concentrate (Comite®, Omite® 6E); all handlers must put on coveralls over normal work clothes (i.e., long pants, a long-sleeved shirt, shoes plus socks), plus headgear and chemical-resistant gloves as per label specifications; in addition, mixer/loaders must use a closed system and a chemical-resistant apron.

[b] liquid formulation upon mixing (Omite®-30WS); handlers are otherwise not required by labels to put on coveralls, headgear, or gloves or to use a closed system for mixing/loading (as water soluble bag has the effect of a closed system for mixing/loading); note that the three handheld equipment scenarios are included primarily for completeness, since it is not practical to apply this formulation using handheld equipment for large-scale operations (e.g., >10 acres) as the entire bag must be used and each bag calls for a minimum of 17 gallons of spray solution per acre (e.g., for application to peanuts).

2. Reentry Exposure

Table I-B lists the potential reentry scenarios for fieldworkers as a result of the scoping exercise. This list was built upon the concept and framework of the more comprehensive generic list that is being finalized at WHS for use to start off a new scoping. From Table I-B, representative scenarios were further identified for use to cover more practically all the reentry activities required for crops/sites on which propargite has been used considerably.

These representative scenarios, or often referred to as surrogate scenarios, were used to assess the reentry exposure for the group of scenarios that they each represent. It was important to generate these representative scenarios because, in this case and in most others, there were not sufficient crop-specific data on DFR (dislodgeable foliar residues) and not sufficient task-specific data on dermal TR (transfer rate) with which one could assess every potential reentry scenario scoped. Many potential reentry scenarios thus must be assessed through use of a representative or "surrogate" reentry scenario. It is also important to note that for health protection reasons, the reentry exposure estimated for such a representative scenario must be, at least by anticipation, equal to or greater than those for the individual scenarios that the surrogate represents. The list of representative reentry scenarios generated for this reentry exposure assessment (Table I-C) and a brief description of the scoping procedure are provided in the two subsections that follow.

A. Scoping Procedure for Reentry Exposure

The following procedure was used to identify as well as to consider the potential scenarios for fieldworkers who may come in contact with propargite residues upon entry to a treated field. First, upon a review of the currently registered product labels, reentry scenarios were scoped to determine crops where the active ingredient propargite is applied. Within the treated crops, reentry activities that might result in fieldworkers having considerable contact with treated foliage were chosen according to WHS current practice. A table with several data-entry columns (e.g., Table I-B) was used to compile a comprehensive list of cultivation activities for each crop after consultation with several sources. Activities during which the contact frequency and intensity deemed high enough were considered in the scoping. Crops having similar structural form and foliage were typically grouped together to reduce un-necessary redundancy. The compiling and the grouping efforts were made according to both the observation and the judgment of WHS scientists.

In essence, the scoping table started off listing the sites of presumably all or nearly all the production agriculture commodities in California and their associated cultural practices (i.e., reentry activities). Rows (crops) in the table that did not contain use sites that appear on one or more product labels for propargite were then taken out, leaving sites and activities that should be considered in assessing potential pesticide exposure.

B. List of Representative Reentry Scenarios

The pre-targeted representative activities generated from this scoping were, as usual, reduced to a short list including only those for which there were DFR and TR data available to calculate the reentry exposures of concern. This shorter and hence more practical list of reentry scenarios, together with their scope of representation, is summarized in Table I-C.

Table I-B. Potential Reentry Activities for Agricultural Fieldworkers, Based on Propargite Use in California

Site/Crop Category[a]	Use site	Potential Reentry Activities[b]
FC	Alfalfa (for seed)	Scouting; mechanical harvesting; irrigating; swathing
FC	Clover (forage)	Scouting; mechanical harvesting; irrigating; swathing
FC	Corn (field/sweet)	Hand/mechanical harvesting; scouting; detasseling; irrigating; weeding
FC	Cotton	Scouting; mechanical harvesting; irrigating; hand weeding/roguing
FC	Grain sorghum	Scouting; irrigating; mechanical harvesting; swathing
FC	Jojoba (oil crop)	Scouting; irrigating; mechanical harvesting
FN	Almonds; walnuts	Scouting; irrigating; mechanical harvesting; weeding; transplanting/propagating; pruning (dormant)
FN	Oranges/grapefruit (post-harvest)	Scouting; irrigating; pruning
FN	Cherries (post-harvest)	Scouting; irrigating; pruning
FN	Grapes	Hand harvesting; scouting; thinning; tying/training/trellising; cane turning; irrigating; transplanting/propagating; suckering; girdling; packing
FN	Nectarines	Hand harvesting; scouting; irrigating; training/pruning (dormant); transplanting/propagating
FN	Non-bearing berries	Scouting; irrigating; weeding; mulching; training; transplanting/propagating; removing old plastic pipes
FN	Non-bearing nut trees	Scouting; irrigating; weeding; transplanting/propagating; pruning (dormant)
FN	Non-bearing tree fruit	Scouting; irrigating; weeding; pruning/tying (dormant); transplanting/propagating; baiting/trapping; chopping
OT	Christmas trees/conifers (for plantation only)	Scouting; irrigating; transplanting; thinning
OT	Roses (field-grown)	Hand harvesting; scouting; irrigating; weeding
Veg	Dry Beans	Mechanical harvesting; scouting; irrigating; weeding; tying; staking
Veg	Potatoes/peanuts	Scouting; mechanical harvesting; irrigating; weeding

[a] FC = *field crops*; FN = *fruits and nuts*; OT = *ornamentals, trees, and nursery/greenhouse*; Veg = *vegetables*.

[b] except for a small number of cultivation activities (e.g., hand harvesting; grape cane turning; leaf thinning; fruit pruning), many listed here are for completeness only and are expected to involve little reentry exposure, in part because of low dermal contact with foliage and in part because of the rather short exposure duration involved; for example, there are worker activities data (*see,* e.g., Edmiston *et al*., 1999) showing that the hours for weeding constitutes less than 1% of the hours required for all cultural activities taken in a peach orchard; but more importantly, many of the activities listed here usually take place before a pesticide application is made or long after it is made; a more practical list of the reentry scenarios for propargite is given in Table I-C.

Table I-C. Practical Representative Reentry Scenarios

Reentry Scenario	*Earliest Reentry Days*[a]	*Scope of Representation*
Corn harvesters	*30 (PHI)*	harvesting corn by hand
Corn detasselers	7	detasseling corn by hand
Cotton/corn scouts	7	not for scouting other crops[b]
Grape cane turners/girdlers	30	turning canes and girdling for all grape types
Grape harvesters/other cultivators	30	including all other related activities
Nectarine harvesters	21	harvesting by hand
Nectarine pruners/leaf thinners	21	including cherries[c] and all other related activities
Citrus pruners/leaf thinners	42	for oranges and grapefruit during post-harvest
Rose harvesters	3(7)	harvesting/cutting field-grown (for aerial spray)
Jojoba harvesters	21	harvesting by hand
Christmas tree transplanters	21	including conifers for plantation
Strawberry transplanters	10	transplanting non-bearing strawberries
Dry bean harvesters	21	mechanical harvesting
Almond harvesters	28	(mechanical) floor shaking and sweeping
Walnut harvesters	21	(mechanical) floor shaking and sweeping
Potato/peanut harvesters	21	mechanical harvesting
Alfalfa/clover seed harvesters	21	mechanical harvesting
Grain sorghum harvesters	21	mechanical harvesting
Irrigators/other cultivators	21	including all not mentioned above in this table[d,e]

[a] since last application; based on the PHI (pre-harvest interval) or the REI (restricted entry interval) specified on product labels, or on the REI specified in Title 3, *California Code of Regulations*, Section 6772, or on the REI specified on the Special Local Need labels, whichever is the practical longest that is in force.

[b] for scouting other crops, use the low-contact reentry activities assumed here for other (non-grape) cultivators as surrogates instead, since the REI for scouting corn is 7 days and for other crops is 21 days; the Comite label does specify an REI of 13 days for *sweet* corn but a somewhat higher DFR level (hence an REI of 7 days) is warranted due to the uncertainty with lack of crop-specific DFR data (*see* Subsection V-2.B in text).

[c] cherries are allowed to be treated during the post-harvest period only; nectarine pruners/leaf thinners are used as surrogates for cherry pruners/leaf thinners for lack of more appropriate DFR data (*see* Subsection V-2.E).

[d] for all crops regardless of differences in REI, since data on a crop with very high DFR and a very slow foliar dissipation rate will be conservatively used to calculate the reentry exposure for this worker group; also, the daily exposure for irrigators is assumed to be 8 hours long when their irrigating work lasts only a few hours on most any day (*see,* e.g., Edmiston *et al*., 1999).

[e] including all those other presumably low-contact activities listed in Table I-B but not mentioned in this table, such as transplanting all allowed non-bearing plants other than small Christmas tree and conifer stocks and non-bearing strawberries; that is, essentially for all low-contact activities with a dermal transfer rate TR around 1,500 µg/hr per $\mu g/cm^2$ of DFR or lower; for this worker group, data on a crop with very high DFR and a very slow foliar dissipation rate will be conservatively used to calculate the reentry exposure.

Appendix II
Use of Dislodgeable Foliar Residues for Reentry Exposure to Propargite

Of all types of environmental concentrations, DFR (dislodgeable foliar residues) are perhaps those most relevant to occupational exposure received in an agricultural setting. The amount of pesticide residues that can be rinsed off the foliage surface is considered to be, for the purpose of reentry exposure assessment, *dislodgeable* and presumably able to adhere to skin and clothing. It is this amount that is subject to dermal contact by fieldworkers entering a treated area. The amount of DFR available on foliar surface is basically a function of their dissipation behavior and the application rate used (but only within a practical range).

By virtue of their job function, many groups of fieldworkers are subject to exposure from dermal contact with dislodgeable residues on foliage treated with propargite. These include, but are not limited to, harvesters, rose cutters, cotton scouts, irrigators, and those that perform cane or shoot turning, leaf pulling, leaf thinning, or girdling (especially in grape vineyards). Data on *daily* reentry *exposure* to propargite for these fieldworkers were not available to WHS. Also, it is logistically impractical to monitor this type of exposure every day over a long period. To estimate the reentry exposures of these workers, it was thus necessary to extrapolate the dermal exposure from available DFR data. The extrapolation algorithm was based on the well-received, but not fully validated, assumption used in pesticide exposure assessment, that (*exposure*) = (*residue concentration*) x (*contact* or *transfer rate*). For reentry exposure to propargite, DFR level was the intended residue concentration. When multiplied by an appropriate dermal TR (transfer rate), the DFR under study may be readily converted to hourly (and hence daily) dermal exposure of fieldworkers entering a treated area.

In reentry exposure assessment, dermal TR is not only a key concept but also a critical tool. By convention, this term is defined as the ratio of hourly dermal exposure expressed typically in µg/hr to DFR in µg/cm^2 or, in a few cases, as some other mathematical relation (e.g., linear regression). In light of this definition, TR is thus used interchangeably with such terms as dermal transfer factor and dermal transfer coefficient. Strictly speaking, the ratio is more correctly referred to as a transfer *rate* since both the terms *coefficient* and *factor* are used to represent a numerical quantity without units. For lack of consistency and the fact that sometimes some other relations may be used to correlate dermal exposure with DFR, the term *transfer factor* or *transfer coefficient* has been used more often than not by many other exposure assessors. In calculating the TR for cotton scouts, Dong (1990) provided an example relating the reentry exposure and the DFR involved by means of linear regression.

The pesticide residues that were monitored for reentry exposure could be those present directly on the fieldworker's skin or alternatively on their work clothes and gloves. The TR calculated from the latter type of monitored dermal exposure is hence often necessarily qualified with the term *potential* in order to make the distinction. The term DFR, that used as the denominator in the TR calculation, is traditionally defined as the amount of pesticide residues that can be removed from *both* sides of treated foliage surface by means of some conventional (standardized) mechanical agitation and aqueous surfactant. Guidance has been given regarding the statistical (Andrews, 2000) and the laboratory (del Valle, 1999) analysis of DFR, as well as the procedures for their sample collection (Edmiston *et al*., 2002).

Because TR is basically a ratio of dermal to foliar residues, it is not only task- but also crop- and even chemical-specific. Dermal TR is task-specific in that the intensity and frequency of dermal contact is highly activity-related. To a lesser extent, it is also related to the crop group involved since the dislodgeability and transferability of DFR can be a function of this variable. Here by crop group, it also implies such subtle variables as surface texture of foliage, weather, and time of plantation, which may have an effect on how easily foliar residues are dislodged and transferred onto a worker's skin or clothes and stay on these dermal or clothing surfaces long enough to be monitored. It is based on this understanding that there is a tendency for pesticide exposure assessors to cluster the TR by task as well as by crop group. This also explains why, for example, the dermal TR for cotton scouts is treated as conceptually different from that for strawberry harvesters, despite the fact that their mean observed values (*see,* e.g., Dong, 1990, 1999) were found to be close to each other.

It is practical to extrapolate *daily* reentry exposures with DFR data because the DFR for each day can be approximated from using their dissipation behavior. As asserted by Willis and McDowell (1987) and supported by the data in Figures II-A through II-P, in many cases the DFR dissipation may be described by the following first-order exponential decay process:

$$\log_{10} [\mathrm{DFR}_t] = \log_{10} [\mathrm{DFR}_0] + (-k)t,$$

where DFR_0 is the initial deposition (day 0 post-application), $-k$ is the foliar dissipation rate constant = $-\log_{10} [2] \times (t_{1/2})^{-1}$, and t is time since application. The above log-linear regression may also be expressed as $\mathrm{DFR}_t = (\mathrm{DFR}_0) \times [10^{(-k)t}]$. (Note that $t_{1/2}$ is the half-life.)

The dissipation of DFR is specific to a crop group within which each crop is presumably subject to similar meteorological conditions and other external factors such as the foliage's biological makeup or its fullness. Table II-A lists all of the foliar dissipation statistics used in the present assessment for reentry exposure to propargite. These statistics were derived from the log-linear regressions characterized in Figures II-A through II-P. The log-linear regressions, performed using the program SigmaPlot® for Windows (version 8.0, SPSS, Inc.), were based on the general procedures outlined in Andrews (2000). More specifically, foliar samples collected within the first 24 hours post-application were excluded from regression analysis, primarily for the concern that certain time lapse is required for residues to settle on the foliage surface and to be stabilized with a new pH and moisture environment. The DFR data used to perform the regressions are briefly discussed below by crop group, which again presumably subsumes certain reentry activities. The crop groups used are largely consistent with those used by U.S. EPA (Tadayon, 2000), but are more in line with the California uses and focuses. To the extent feasible, the DFR data included here were limited to those from studies conducted in California due to consideration of meteorological and use compatibility.

Almonds (Tree Nuts). DFR data from a study on almonds (Kludas, 1991) were submitted with the initial intent to represent almonds and all other tree nuts (e.g., walnuts). In that study, Omite-6E was applied to the Nonpareil variety in Madera, California using airblast spray equipment. The orchard was sprayed twice 28 days apart at the rate of 3.0 lb AI/acre. Foliar samples were taken at 4, 11, 18, and 27 days post-first application, and 1 hour, 4 days, 7 days, 14 days, 21 days, 28 days, and 35 days post-second application.

Table II-A. Dissipation of Dislodgeable Foliar Residues by Crop Group[a]

Crop Group	Predicted Initial Deposition, µg/cm^2	Estimated Dissipation Rate, µg/cm^2 per day	R^2	Study Application Rate, lb AI/acre[b]	Formulation	Reference
Almonds (Tree Nuts)	4.1352	-0.0276	0.8912	3.00 (2nd)	Omite-6E	Kludas, 1991
Alfalfa (Legume)	1.9151	-0.0467	0.9805	2.46 (3rd)	Comite	Popadic, 1993
Dry Beans (Legume)	3.9012	-0.0486	0.9598	2.46 (2nd)	Comite	Gaydosh, 1990
Corn (Cereal Grains)	0.9627	-0.0231	0.7385	2.46 (1st)	Comite	Polakoff, 1989a
Cotton (Oil Seed)	1.7010	-0.0453	0.9134	1.64 (3rd)	Comite	Polakoff, 1990
Grapes (Small Fruits)	1.6607	-0.0316	0.9630	2.88 (2nd)	Omite-30W	Jones, 1989
Hops (Herbs/Spices)	3.0882	-0.0192	0.8240	1.35 (2nd)	Omite-CR	Tadayon, 2000
Nectarines (Stone)	1.9373	-0.0229	0.9188	2.25 (1st, p-h)	Omite-30W	Siemer, 1988
Peaches (Stone)	3.3289	-0.0287	0.9868	2.25 (1st)	Omite-30W	Siemer, 1988
Peaches (Stone)	2.3725	-0.0172	0.7978	3.00 (1st)	Omite-30W	Siemer, 1988
Oranges (Citrus)	2.8635	-0.0101	0.9161	3.15 (1st)	Omite-CR	Siemer, 1989
Oranges (Citrus)	4.4545	-0.0101	0.9818	4.50 (1st)	Omite-CR	Siemer, 1989
Oranges (Citrus)	4.3702	-0.0125	0.9559	4.50 (1st)	Omite-30W	Siemer, 1989
Field-Grown Roses	4.2413	-0.0640	0.8493	1.50 (1st)	Omite-30WS	Fong *et al.*,
Strawberries	1.1079	-0.0443	0.9978	0.90 (3rd, late)	Omite-30W	Polakoff, 1989b
Strawberries	1.4622	-0.0334	0.9746	1.50 (3rd, late)	Omite-30W	Polakoff, 1989b

[a] the dissipation of propargite dislodgeable foliar residues (DFR) was approximated with the following log-linear regression: $\log_{10}$ (DFR) = [$\log_{10}$ (initial deposition) + (dissipation rate) x (days post-application)], as described in the text in this appendix; the DFR data used to construct the log-linear regression are presented in Figures II-A through II-P; and R^2 above is the resultant coefficient of determination (with R being commonly known as the correlation coefficient).

[b] in parentheses following the rate is the total applications after which foliar samples for the analysis were taken; p-h ≡ post-harvest, and late ≡ ~ autumn months (atypical timing for application) which yielded 3.5 times as much DFR as did summer months (typical timing for application).

[c] note that only Comite, Omite-6E, and Omite-30WS are currently actively registered in California, and are thus the only ones subject to exposure assessment here.

Beans/Alfalfa. DFR data from two studies, one on alfalfa (Popadic, 1993) and the other on dry beans (Gaydosh, 1990), were submitted with the initial intent to represent legume and tuber vegetables or forages (e.g., potato, carrot, dry beans, alfalfa, clover). In the alfalfa study, Comite was sprayed to the CUF101 variety in Kerman, California using a ground- boom sprayer. The alfalfa was treated three times approximately 25 days apart at 2.46 lb AI/acre. Foliar samples were taken at pre-treatment, 1 hour, 3 days, 7 days, 14 days, 21 days, 28 days, and 35 days after the third application. In the dry bean study, Comite was applied to Red Kidney Beans in Hughson, California using a CO_2 boom sprayer. The dry beans were sprayed twice 21 days apart at 2.46 lb AI/acre. Foliar samples were taken at 3, 9, and 16 days post-first application, and 1 hour, 3 days, 7 days, 14 days, 21 days, 28 days, and 35 days post-second application. Pretreatment samples were also taken prior to each application.

Cereal Grains/Seed Corn. DFR data from a study on seed corn (Polakoff, 1989a) were submitted with the initial intent to represent (seed or other) corn and cereal grains. In that study, Comite EC was applied once to seed corn in McAllen, Texas at 2.46 lb AI/acre using ground application equipment. Foliar samples were taken at pre-treatment, 1 hour, 3 days, 7 days, 14 days, 21 days, and 28 days post-application.

Cotton/Oil Seed. DFR data from a study on cotton (Polakoff, 1990) were submitted with the initial intent to represent cotton and oil seed. In that study, Comite was applied three times to cotton in Hanford, California. Propargite was applied each time at the rate of 1.64 lb AI/acre via a high-clearance ground sprayer. The third application was made prior to boll opening. Foliar samples were taken at pre-treatment, 1 hour, 2 days, 7 days, 14 days, 21 days, and 28 days following the third application. Foliar samples were also taken following the first two applications, but only three times within the first 17 days following application.

Grapes/Small Fruits. DFR data from a study on grapes (Jones, 1989) were submitted with the initial intent to represent grapes and other small fruit crops not covered in this appendix as the worst case. In that study, Omite-30W was applied to Thompson seedless grapes in Madera, California at 2.88 lb AI/acre using a commercial airblast spray rig. Foliar samples were taken at 1 hour, 3 days, 7 days, 14 days, 22 days, 28 days, and 35 days following a second application made 36 days after the first. Samples were also taken at 9, 16, and 23 days following the first spray.

The DFR data on grapes from two studies by WHS staff (Maddy *et al.*, 1986; Reeve *et al.*, 1991) were excluded from consideration here because the correlation of determination R^2 was below 0.5 for several trials in the two studies. Also excluded was a survey type study by the WHS exposure monitoring program (Spencer and Edmiston, 2003). That survey type study included 11 trials conducted in 1990, with 5 in Fresno County and 6 in Kern County, that came with known post-application dates (for sample collection) and known application rates. Those 11 trials were not used in the present assessment in part because the initial depositions projected from them varied greatly. After normalization to 1 lb of propargite AI per acre of grapes treated, the projected initial depositions ranged from 0.26 to 2.92 μg/cm^2, with an average of 1.19. As those trials were the results of a survey study providing very limited information on application history, actual application rate used, meteorological details, and field conditions, it is difficult to resolve the variability issue on initial deposition. Yet more

Given that the REI at issue is 30 days or longer, it was deemed more health protective to have a bias toward a lower dissipation rate than toward a higher initial deposition, at least for this case supported by the data in hand. A comparison of the dissipation statistics showed that the DFR projected from the selected study (i.e., that by Jones, 1989) for REI = 30 days is higher than those from all the 11 trials in the survey study except one. The one exception had simply an insignificantly higher DFR of 0.20 μg/cm^2 (*vs.* 0.19 μg/cm^2) for day 30, while with an insignificantly lower R^2 of 0.95 (*vs.* 0.96). In short, it appears that at this point, at least for REI = 30 days or longer, the selected study has provided the most health protective as well as the best quality dissipation statistics for use to estimate the reentry exposures at issue.

Herbs/Spices/Hops. DFR data from a study on hops were used to represent the residues on spices and herbs. To this date, that study has not been submitted to DPR for review, but was described in U.S. EPA's exposure assessment document (Tadayon, 2000). In that study, Omite-CR was ground sprayed to hops twice in Grauger, Washington, each at 1.35 lb AI/acre. Foliar samples were taken at 3, 7, 14, 21, and 28 days post-first application, and 1 hour, 3 days, 7 days, 14 days, 21 days, and 28 days post-second application.

Nectarines/Stone Fruits. DFR data from a study on nectarines and peaches (Siemer, 1988) were submitted with the initial intent to represent nectarines and other stone fruits. (Note that currently, those data are not applicable for other stone fruits since the labels do not allow the use on other fruit-bearing stone fruits including peaches). In that study, Omite-30W was applied to both crops using airblast spray equipment. For nectarines, the spray solution was applied to the foliage once *post-harvest* in Traver, California, at the rate of 2.25 lb AI/acre. Foliar samples were taken at pre-treatment, 1 hour, 3 days, 7 days, 14 days, 21 days, 28 days, 35 days, 42 days, 49 days, and 64 days post-application. For peaches, two orchards were sprayed once at 34 days pre-first harvest in Easton, California, at the rates of 2.25 and 3.0 lb AI/acre. Foliar samples were taken at pre-treatment, 1 hour, 3 days, 7 days, 14 days, 21 days, 28 days, and 34 days post-application. Post-harvest samples were also taken from the peach orchards at 34, 39, 45, and 59 days post-application.

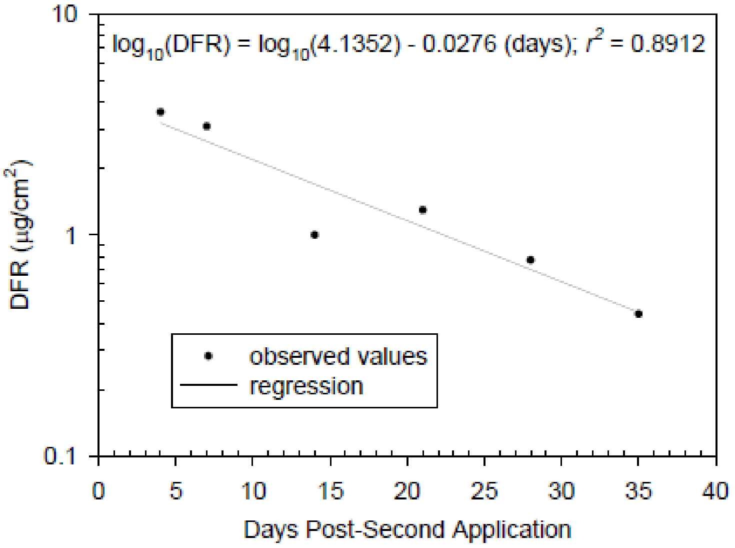
In another study also on peaches (Polakoff, 1989c), Omite-30W was applied in Turlock, California using an airblast sprayer, at the rate of 4.5 lb AI/acre. Foliar samples were taken at pre-treatment, 1 hour, 3 days, 7 days, 14 days, 21 days, 28 days, and 35 days post-application. The DFR data from that study were not considered in this assessment revision, as they did not support a log-linear dissipation over time. The study revealed two log-linear dissipations occurring within the same sampling period, with one starting at day 3 post-application and the other at day 21. The DFR data from a WHS study on nectarines (Smith, 1989) were also not considered in the present assessment because the foliar samples were first taken 2 to 5 weeks post-application.

Oranges/Citrus. DFR data from a study on oranges (Siemer, 1989) were used to represent citrus. In this study, propargite was applied once to navel oranges near Riverside, California at 3.15 lb AI (Omite-CR) and 4.5 lb AI (Omite-CR, Omite-30W) per acre using airblast spray equipment. Foliar samples were taken at pre-treatment, 1 hour, 3 days, 7 days, 14 days, 21 days, 28 days, 35 days, 42 days, and 70 days post-treatment. A survey was also submitted by the registrant Uniroyal Chemical (Cardona, 1986), in which 212 samples of citrus foliage from various applications and sites were collected and analyzed for foliar dislodgeables of propargite. The DFR data from that survey were not considered in this assessment, as no details were given regarding the specific application rates and the specific citrus involved. Also excluded from consideration were the DFR data from a study by WHS staff (Saiz and Schneider, 1987), in which foliar samples were collected from orange groves treated with Omite-CR in Tulare, California. The Tulare data were included for cross-reference purposes only since a range (2.7 to 3.3 lb AI/acre) based on application records filed, instead of a known application rate, was reported. The Tulare study was conducted following the investigation of an outbreak occurring in that county in 1986.

Field-Grown Roses. DFR data from a WHS study (Fong *et al*., 1990) were used to represent field-grown roses. In that study, Omite-30WS was ground sprayed to roses grown in fields near Wasco, California at 1.5 lb AI/acre. Foliar samples were taken from Fields 101, 502, 701, and 902, at pre-treatment, 0, 1, 2, 3, 4, 7, 8, 10, 11, 14, 15, and 21 days post-application. Those foliar samples were assumed to be from a single application, since no reapplication history prior to the collection time was given. Only samples taken at Field 701 were used in the present assessment for field-grown rose harvesters/cutters, as they yielded the highest correlation of determination ($R^2 = 0.85$) along with a fairly high initial deposition and a fairly low foliar dissipation rate.

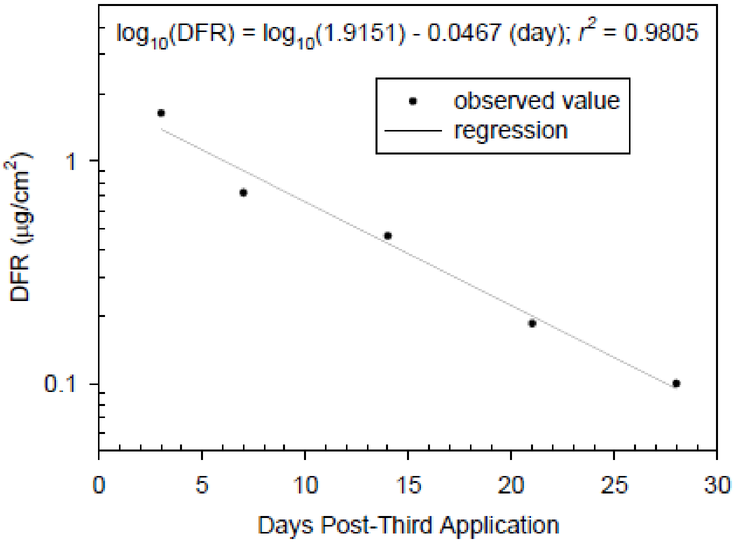
Strawberries. DFR data from an experimental study on strawberries (Polakoff, 1989b) were used to represent (non-bearing) strawberries and other berries (for reentry activities other than harvesting, as propargite is not allowed to be used on fruit-bearing berries). In that study, propargite was applied to strawberries of three varieties (Selva, Pajaro, Muir) in two locations in California during the summer (in Santa Maria and Salinas) and winter (in Salinas) months of 1988. The strawberries were boom sprayed with Omite-30W at 0.90 lb AI/acre (all three varieties in the summer and the Muir variety in the winter) and at 1.5 lb AI/acre (Muir in the winter), and with Omite-CR at 1.5 lb AI/acre (all three varieties in the summer). Up to three applications were made per site and per application rate; and all were made at 7-day spray intervals where weather permitted. Foliar samples were taken from the winter trials at 3, 6, 13, and 20 days after the third applications (of Omite-30W at 0.09 and 1.5 lb AI/acre). Samples were also taken at 3 days after each application from all test locations. Those samples showed that, on average, the DFR from the late season (atypical timing) application were 3.5 times higher than those from summer sprays. The study suggested that "*The cooler temperatures throughout the duration of the later segment of work may be the factor influencing the level of dislodgeable residues*." Another crucial factor might have been that different types of application equipment were employed. The summer and autumn sprays were made using, respectively, a bicycle test plot sprayer with strawberry boom and a commercial John Deere tractor strawberry sprayer.

Figure II-A. Dissipation of Propargite Dislodgeable Foliar Reisudes (DFR) on Almonds (Omite 6E, 3.00 lb AI/Acre)



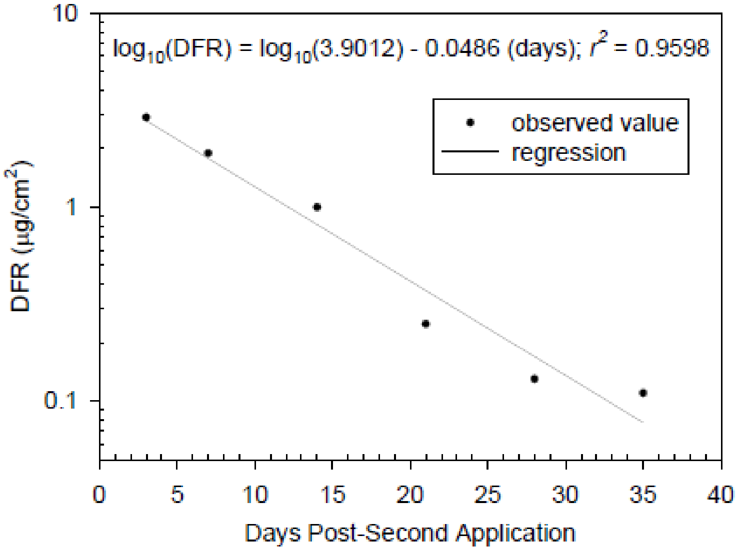
Days	4	7	14	21	28	35	Source
DFR	3.60	3.10	1.00	1.30	0.77	0.44	Kludas, 1991

Figure II-B. Dissipation of Propargite Dislodgeable Foliar Residues (DFR) on Alfalfa (Comite, 2.46 lb AI/Acre)



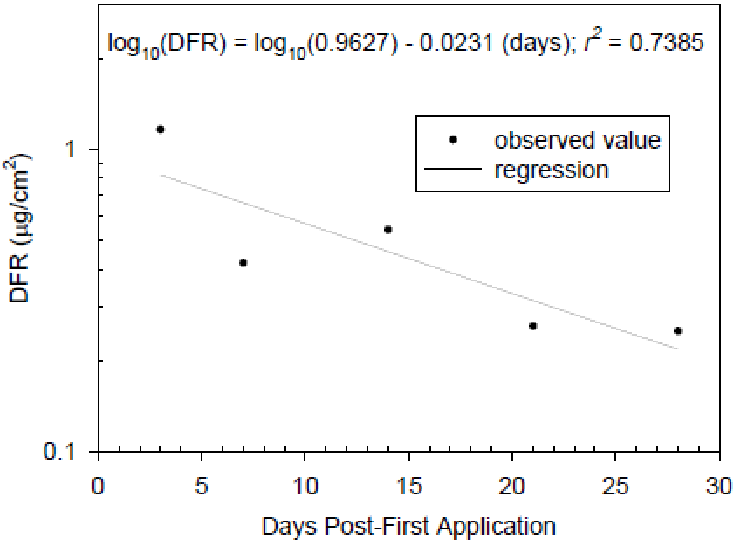
Days	3	7	14	21	28	Source
DFR	1.64	0.72	0.46	0.19	0.10	Popadic, 1993

Figure II-C. Dissipation of Propargite Dislodgeable Foliar Residues (DFR) on Dry Beans (Comite, 2.46 lb AI/Acre)



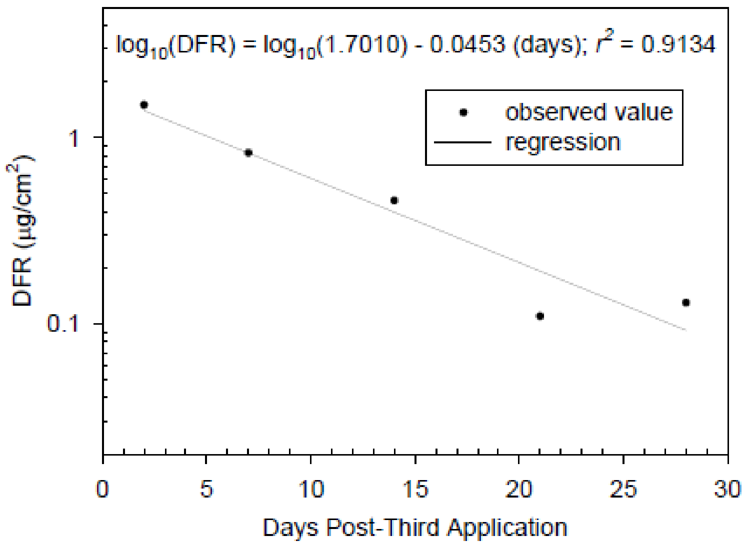
Days	3	7	14	21	28	35	Source
DFR	2.90	1.90	1.00	0.25	0.13	0.11	Gaydosh, 1990

Figure II-D. Dissipation of Propargite Dislodgeable Foliar Residues (DFR) on Corn (Comite, 2.46 lb AI/Acre)



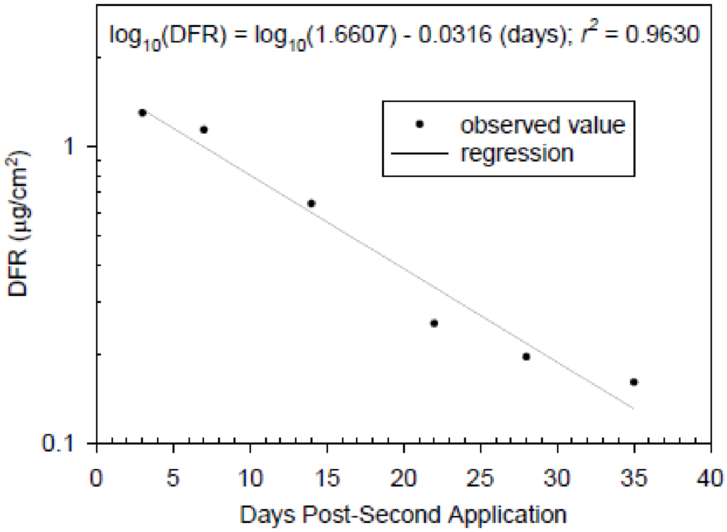
Days	3	7	14	21	28	Source
DFR	1.16	0.42	0.54	0.26	0.25	Polakoff, 1989a

Figure II-E. Dissipation of Propargite Dislodgeable Foliar Residues (DFR) on Cotton (Comite, 1.64 lb AI/Acre)



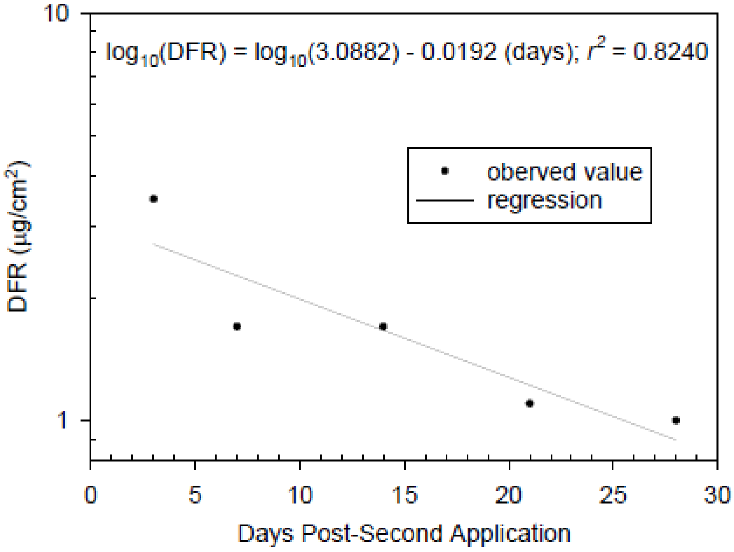
Days	2	7	14	21	28	Source
DFR	1.50	0.83	0.46	0.11	0.13	Polakoff, 1990

Figure II-F. Dissipation of Propargite Dislodgeable Foliar Residues (DFR) on Grapes (Omite 30W, 2.88 lb AI/Acre)



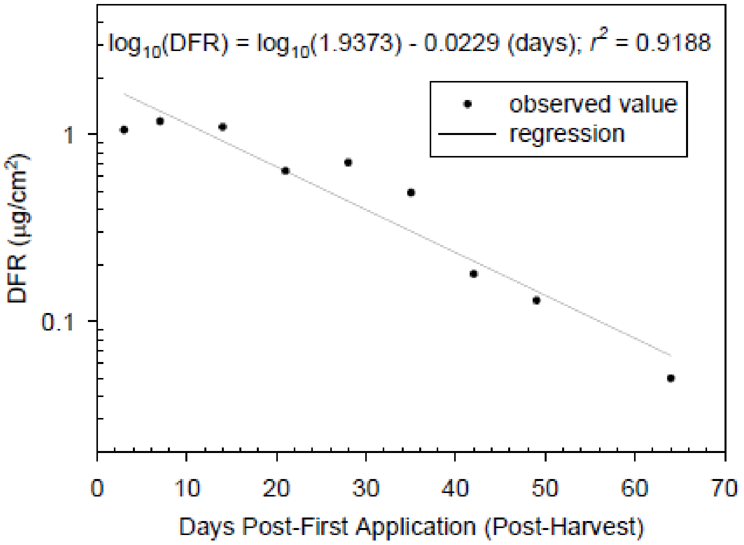
Days	3	7	14	22	28	35	Source
DFR	1.30	1.14	0.64	0.25	0.20	0.16	Jones, 1989

Figure II-G. Dissipation of Propargite Dislodgeable Foliar Residues (DFR) on Hops (Omite CR, 1.35 lb AI/Acre)



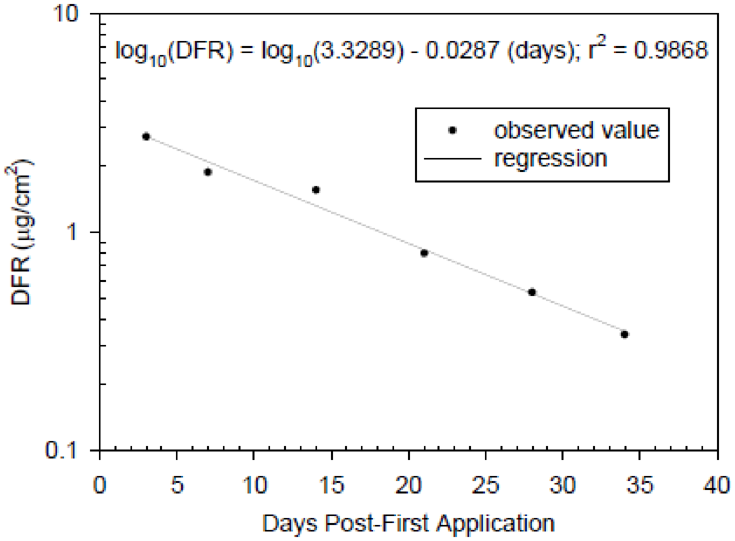
Days	3	7	14	21	28	Source
DFR	3.5	1.70	1.70	1.10	1.00	Tadayon, 2000

Figure II-H. Dissipation of Propargite Dislodgeable Foliar Residues (DFR) on Nectarines (Omite 30W, 2.25 lb AI/Acre)



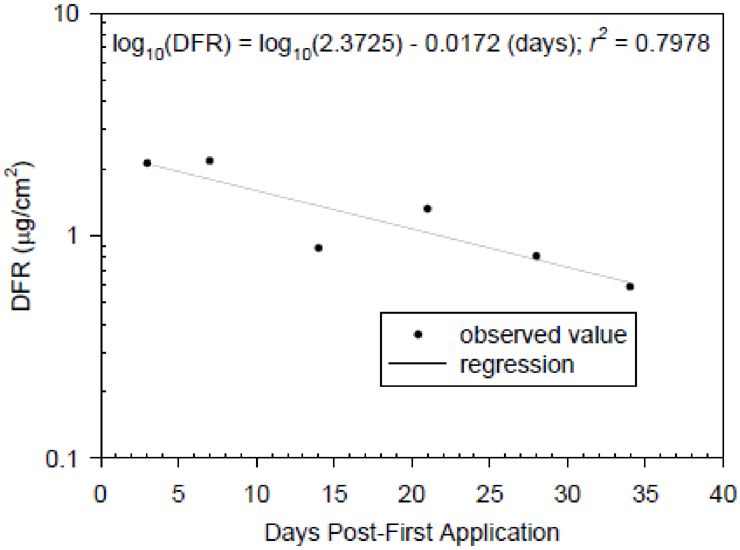
Days	3	7	14	21	28	35	42	49	64	Source
DFR	1.06	1.18	1.10	0.64	0.71	0.49	0.18	0.13	0.05	Siemer, 1988

Figure II-I. Dissipation of Propargite Dislodgeable Foliar Residues (DFR) on Peaches (Omite 30W, 2.25 lb AI/Acre)



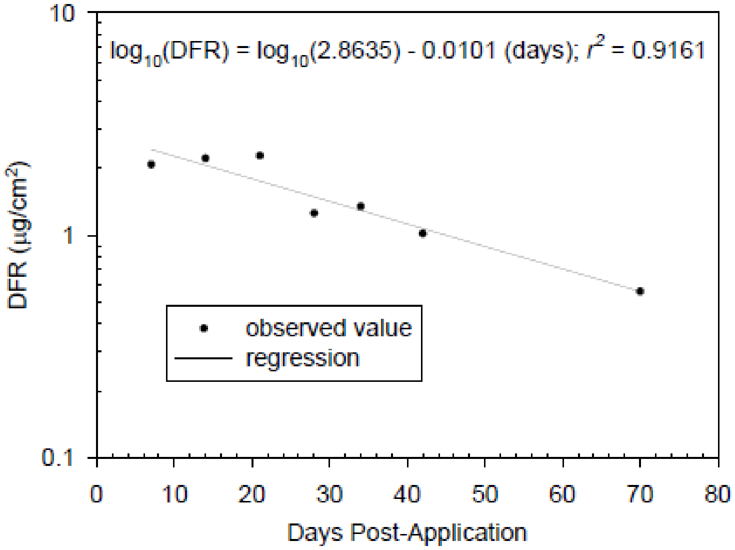
Days	3	7	14	21	28	34	Source
DFR	2.73	1.88	1.56	0.80	0.53	0.34	Siemer, 1988

Figure II-J. Dissipation of Propargite Dislodgeable Foliar Residues (DFR) on Peaches (Omite 30W, 3.00 lb AI/Acre)



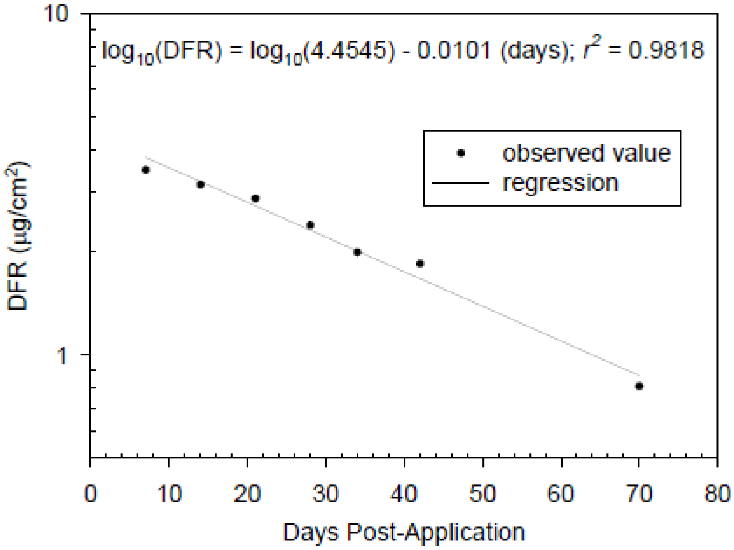
Days	3	7	14	21	28	34	Source
DFR	2.12	2.17	0.88	1.32	0.81	0.59	Siemer, 1988

Figure II-K. Dissipation of Propargite Dislodgeable Foliar Residues (DFR) on Oranges (Omite CR, 3.15 lb AI/Acre)



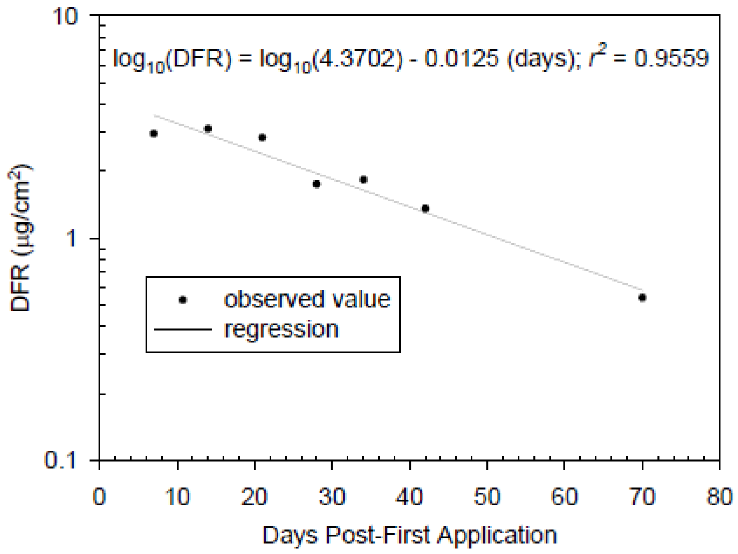
Days	7	14	21	28	34	42	70	Source
DFR	2.08	2.22	2.28	1.26	1.35	1.02	0.56	Siemer, 1989

Figure II-L. Dissipation of Propargite Dislodgeable Foliar Residues (DFR) on Oranges (Omite CR, 4.50 lb AI/Acre)



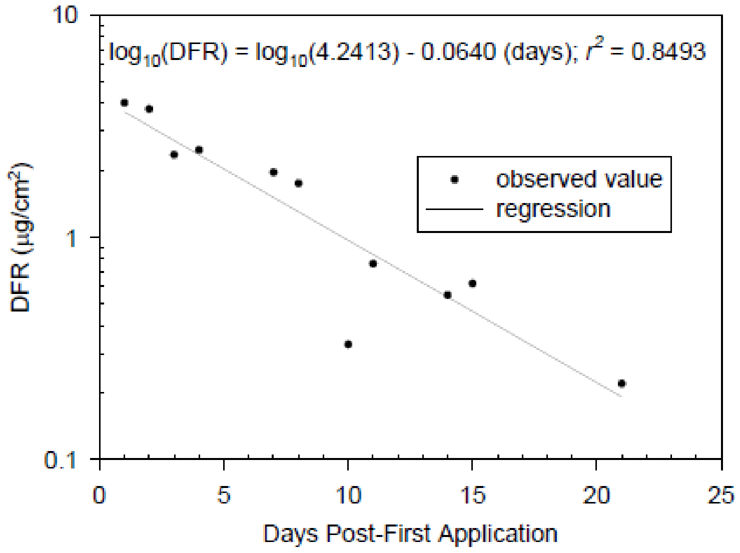
Days	7	14	21	28	34	42	70	Source
DFR	3.48	3.15	2.87	2.40	2.00	1.85	0.81	Siemer, 1989

Figure II-M. Dissipation of Propargite Dislodgeable Foliar Residues (DFR) on Oranges (Omite 30W, 4.50 lb AI/Acre)



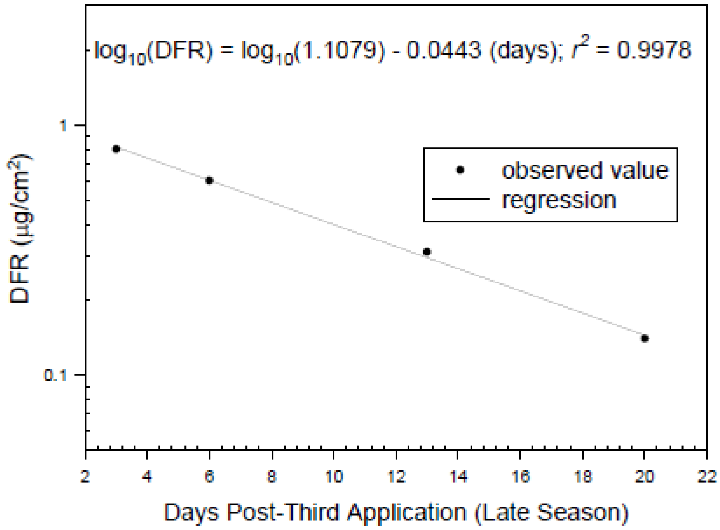
Days	7	14	21	28	34	42	70	Source
DFR	2.95	3.10	2.83	1.75	1.83	1.36	0.54	Siemer, 1989

Figure II-N. Dissipation of Propargite Dislodgeable Foliar Residues (DFR) on Roses (Omite 30W, 1.50 lb AI/Acre)



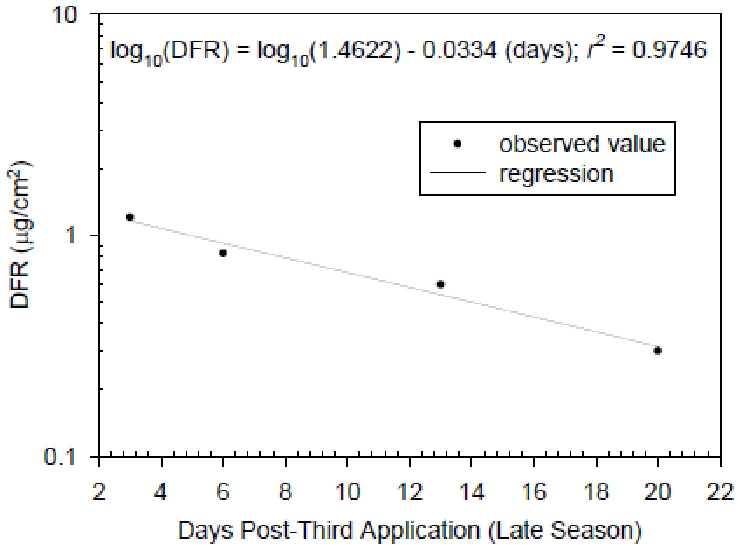
Days	1	2	3	4	7	8	10	11	14	15	21	Source
DFR	4.03	3.78	2.35	2.47	1.96	1.75	0.33	0.76	0.55	0.62	0.22	Fong *et al.*, 1990

Figure II-O. Dissipation of Propargite Dislodgeable Foliar Residues (DFR) on Strawberries (Omite 30W, 0.90 lb AI/Acre)



Days	3	6	13	20	Source
DFR	0.80	0.60	0.31	0.14	Polakoff, 1989b

Figure II-P. Dissipation of Propargite Dislodgeable Foliar Residues (DFR) on Strawberries (Omite 30W, 1.50 lb AI/Acre)



Days	3	6	13	20	Source
DFR	1.21	0.83	0.60	0.30	Polakoff, 1989b

Appendix III-A: Aerial Applicator, Liquids, Open Cockpit

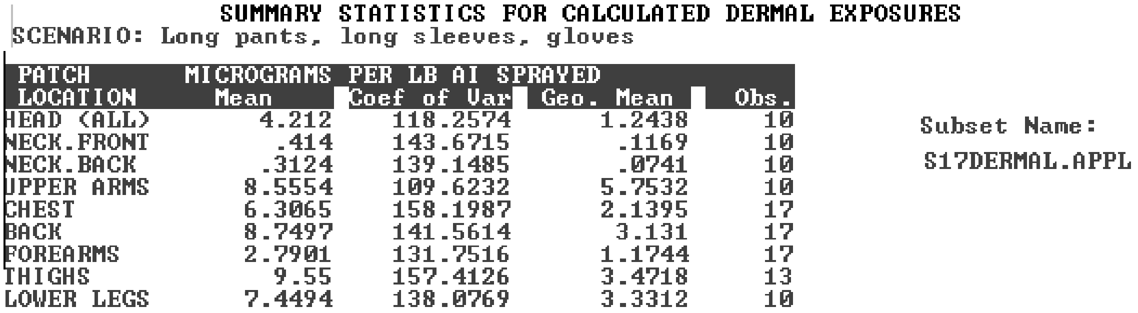
Table 17-1. Description of PHED Subsets for Scenario 17[a]

Parameter	Specifications used to generate subsets[a]	Actual characteristics of resulting subsets
Data Quality Grades[b]	A,B,C	A,B,C
Liquid Type	Not specified	All emulsifiable concentrate
Solid Type	Exclude granular	none
Application Method	Fixed- or rotary-wing	All fixed-wing
Cab Type	Open Cab or Closed Cab with Open Window	Open Cab or Closed Cab with Open Window

[a] subsets of Applicator data in the Pesticide Handlers Exposure Database (PHED). Parameter descriptions are from screens displayed in the PHED program.

[b] data quality for Dermal Uncovered, Dermal Covered, and Hand were Grade A or C; Airborne data were Grade B or C. Data quality grades are defined in the text and in Versar (1992).

Figure 17-1. Summary of Results from the Pesticide Handlers Exposure Database (PHED) Subset for Scenario 17[a]



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                SUMMARY STATISTICS FOR CALCULATED DERMAL EXPOSURES
SCENARIO: Long pants, long sleeves, gloves

 PATCH       MICROGRAMS PER LB AI SPRAYED
 LOCATION      Mean     Coef of Var   Geo. Mean    Obs.
HEAD (ALL)      4.212     118.2574     1.2438      10          Subset Name:
NECK.FRONT       .414     143.6715      .1169      10
NECK.BACK       .3124     139.1485      .0741      10          S17DERMAL.APPL
UPPER ARMS     8.5554     109.6232     5.7532      10
CHEST          6.3065     158.1987     2.1395      17
BACK           8.7497     141.5614      3.131      17
FOREARMS       2.7901     131.7516     1.1744      17
THIGHS           9.55     157.4126     3.4718      13
LOWER LEGS     7.4494     138.0769     3.3312      10
```

[a] subset criteria included actual and estimated head patches. Of the 10 head observations, 7 were actual and 3 were estimated from nearby patches (Versar, 1992).

Table 17-2. PHED data from Dermal, Hand, and Inhalation Subsets[a]

Exposure category	Exposure (µg/lb AI handled)	Replicates in subset	Short-term multiplier[b]	Long-term multiplier[b]
Dermal (non-hand)[c]	52.2	10[d]	6	2
Hand (with gloves)	9.63	9	6	2
Inhalation	0.573	14	5	2

[a] results from subsets of Applicator data in the Pesticide Handlers Exposure Database (PHED). Results rounded to three significant figures.

[b] multipliers are explained in the text and in Frank (2007).

[c] dermal total includes addition of default feet value of 0.52 x (value for lower legs); ratio of feet/lower leg surface area (U.S. EPA, 1997).

[d] median number of replicates was used in determining subset multipliers.

Table 17-3. Values Used in Scenario 17 Exposure Calculations[a]

	Short-Term Exposure		Long-Term Exposure	
Total Dermal (with gloves)	6(52.2) + 6(9.63) =	371 µg/lb AI handled	2(52.2) + 2(9.63) =	124 µg/lb AI handled
Total Dermal (no gloves)[b]	6(52.2) + 60(9.63) =	891 µg/lb AI handled	2(52.2) + 20(9.63) =	297 µg/lb AI handled
Inhalation	5(0.573) =	2.86 µg/lb AI handled	2(0.573) =	1.15 µg/lb AI handled

[a] values from Table 17-2. Results rounded to three significant figures.

[b] gloves assumed to provide 90% protection (Aprea *et al.*, 1994); exposure of bare hands is calculated as ten times exposure of gloved hands.

Appendix III-B: Airblast Applicator, Open Cab (*no gloves*)

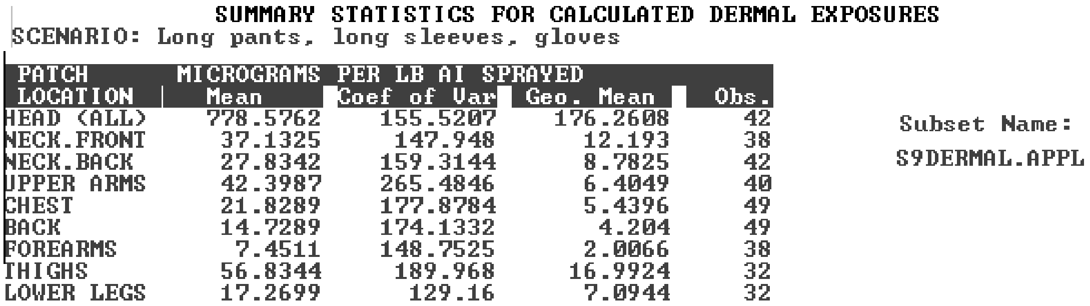
Table 9A-1. Description of Pesticide Handlers Exposure Database (PHED) Subsets[a]

Parameter	Specifications used to generate subsets[a]	Actual characteristics of resulting subsets
Data Quality Grades [b]	A,B	A,B
Liquid Type or Solid Type	Not specified	Emulsifiable concentrate, dry flowable or wettable powder
Application Method	Airblast	Airblast
Cab Type	Open Cab or Closed Cab with Open Window	Open Cab or Closed Cab with Open Window

[a] subsets of Applicator data in the Pesticide Handlers Exposure Database (PHED). Parameter descriptions are from screens displayed in the PHED program.

[b] data quality for Airborne, Dermal Uncovered, Dermal Covered and Hand are all Grade A or B. Data quality grades are defined in the text and in Versar (1992).

Figure 9A-1. Summary of Results from the PHED Dermal Subset for Scenario 9A[a]



```
                SUMMARY STATISTICS FOR CALCULATED DERMAL EXPOSURES
SCENARIO: Long pants, long sleeves, gloves

 PATCH        MICROGRAMS PER LB AI SPRAYED
 LOCATION   |   Mean     Coef of Var  Geo. Mean     Obs.
HEAD (ALL)    778.5762    155.5207    176.2608       42        Subset Name:
NECK.FRONT     37.1325     147.948      12.193       38
NECK.BACK      27.8342    159.3144      8.7825       42        S9DERMAL.APPL
UPPER ARMS     42.3987    265.4846      6.4049       40
CHEST          21.8289    177.8784      5.4396       49
BACK           14.7289    174.1332       4.204       49
FOREARMS        7.4511    148.7525      2.0066       38
THIGHS         56.8344     189.968     16.9924       32
LOWER LEGS     17.2699      129.16      7.0944       32
```

[a] subset criteria included actual and estimated head patches. Of the 42 head observations, 41 were actual and 1 was estimated from nearby patches (Versar, 1992).

Table 9A-2. PHED Data from Dermal, Hand, and Inhalation Subsets for Scenario 9A[a]

Exposure category	Exposure (µg/lb AI handled)	Replicates in subset	Short-term multiplier [b]	Long-term multiplier [b]
Dermal (non-hand) [c]	1,010	40 [d]	4	1
Hand (no gloves)	645	22	4	1
Inhalation	5.41	47	4	1

[a] results from subsets of Applicator data in the Pesticide Handlers Exposure Database (PHED). Results rounded to three significant figures.

[b] multipliers are explained in the text and in Frank (2007).

[c] dermal total includes addition of default feet value of 0.52 x (value for lower legs); ratio of feet/lower leg surface area (U.S. EPA, 1997).

[d] median number of replicates was used in determining subset multipliers.

Table 9A-3. Values Used in Scenario 9A Exposure Calculations[a]

	Short-term exposure	Long-term exposure
Total Dermal	4(1,010) + 4(645) = 6,620 µg/lb AI handled	1(1,010) + 1(645) = 1,660 µg/lb AI handled
Inhalation	4(5.41) = 21.6 µg/lb AI handled	1(5.41) = 5.41 µg/lb AI handled

[a] values from Table 9A-2. Results rounded to three significant figures.

Appendix III-C: Groundboom Applicator, Open Cab

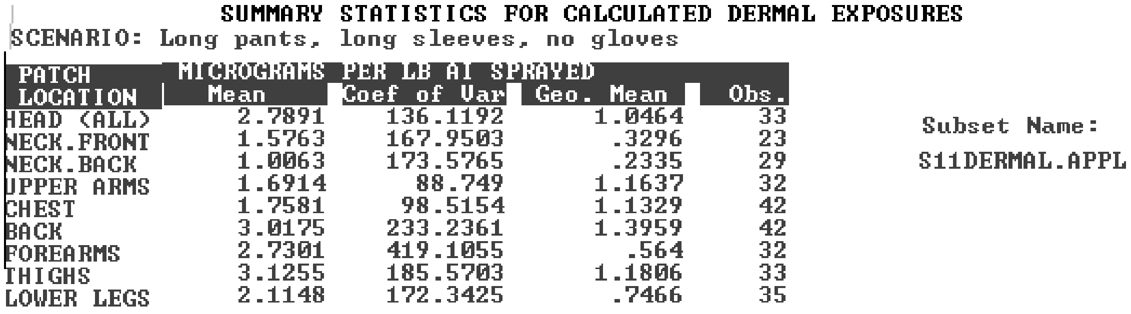
Table 11-1. Description of PHED Subsets for Scenario 11[a]

Parameter	Specifications used to generate subsets [a]	Actual characteristics of resulting subsets
Data Quality Grades[b]	A,B	A,B,C
Liquid Type or Solid Type	Not specified	Emulsifiable concentrate or wettable powder
Application Method	Groundboom, Truck or Tractor	Groundboom, Tractor
Cab Type	Open Cab or Closed Cab with Open Window	Open Cab or Closed Cab with Open Window

[a] subsets of Applicator data in the Pesticide Handlers Exposure Database (PHED). Parameter descriptions are from screens displayed in the PHED program.

[b] data quality grades for Airborne, Dermal Uncovered, Dermal Covered and Hand are all Grade A or B, with the exception of one dermal replicate that has Dermal Uncovered Grade C (Dermal Covered for that replicate is Grade B). Data quality grades are defined in the text and in Versar (1992).

Figure 11-1. Summary of Results from the Pesticide Handlers Exposure Database (PHED) Subset for Scenario 11[a]



```
                 SUMMARY STATISTICS FOR CALCULATED DERMAL EXPOSURES
SCENARIO: Long pants, long sleeves, no gloves

 PATCH      MICROGRAMS PER LB AI SPRAYED
 LOCATION      Mean    Coef of Var   Geo. Mean    Obs.
HEAD (ALL)    2.7891    136.1192       1.0464      33        Subset Name:
NECK.FRONT    1.5763    167.9503        .3296      23
NECK.BACK     1.0063    173.5765        .2335      29        S11DERMAL.APPL
UPPER ARMS    1.6914     88.749        1.1637      32
CHEST         1.7581     98.5154       1.1329      42
BACK          3.0175    233.2361       1.3959      42
FOREARMS      2.7301    419.1055        .564       32
THIGHS        3.1255    185.5703       1.1806      33
LOWER LEGS    2.1148    172.3425        .7466      35
```

[a] subset criteria included actual and estimated head patches. Of the 33 head observations, all were actual.

Table 11-2. PHED Data from Dermal, Hand, and Inhalation Subsets for Scenario 11[a]

Exposure category	Exposure (µg/lb AI handled)	Replicates in subset	Short-term multiplier[b]	Long-term multiplier[b]
Dermal (non-hand)[c]	20.9	33[d]	4	1
Hand (no gloves)	45.6	29	4	1
Inhalation	1.18	22	4	1

[a] results from subsets of Applicator data in the Pesticide Handlers Exposure Database (PHED). Results rounded to three significant figures.

[b] multipliers are explained in the text and in Frank (2007).

[c] dermal total includes addition of default feet value of 0.52 x (value for lower legs); ratio of feet/lower leg surface area (U.S. EPA, 1997).

[d] median number of replicates was used in determining subset multipliers.

Table 11-3. Values Used in Scenario 11 Exposure Calculations[a]

	Short-term Exposure	Long-term Exposure
Total Dermal (with gloves)[b]	4(20.9) + 0.4(45.6) = 102 µg/lb AI handled	1(20.9) + 0.1(45.6) = 25.5 µg/lb AI handled
Total Dermal (no gloves)	4(20.9) + 4(45.6) = 266 µg/lb AI handled	1(20.9) + 1(45.6) = 66.5 µg/lb AI handled
Inhalation	4(1.18) = 4.72 µg/lb AI handled	1(1.18) = 1.18 µg/lb AI handled

[a] values from Table 11-2. Results rounded to three significant figures.

[b] gloves assumed to provide 90% protection (Aprea *et al.*, 1994); exposure of gloved hands is calculated as one tenth exposure of bare hands.

Appendix III-D: Mixer/Loader, Open System, Liquids

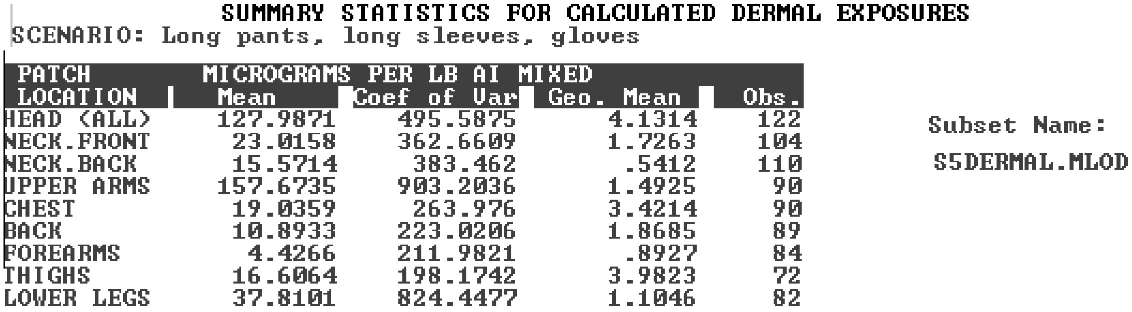
Table 5-1. Description of PHED Subsets for Scenario 5[a]

Parameter	Specifications used to generate subsets[a]	Actual characteristics of resulting subsets
Data Quality Grades[b]	A,B	A,B
Liquid Type	Emulsifiable concentrate, aqueous suspension, microencapsulated, solution, or undiluted liquid	Emulsifiable concentrate, solution
Mixing Procedure	Open	Open

[a] subsets of Mixer/Loader data in the Pesticide Handlers Exposure Database (PHED). Parameter descriptions are from screens displayed in the PHED program.

[b] data quality for Dermal Uncovered, Dermal Covered and Airborne are all Grade A or B; Hand data are all Grade A. Data quality grades are defined in the text and in Versar (1992).

Figure 5-1. Summary of Results from the Pesticide Handlers Exposure Database (PHED) Dermal Subset for Scenario 5[a]



```
                SUMMARY STATISTICS FOR CALCULATED DERMAL EXPOSURES
SCENARIO: Long pants, long sleeves, gloves

 PATCH         MICROGRAMS PER LB AI MIXED
 LOCATION     Mean     Coef of Var  Geo. Mean    Obs.
HEAD (ALL)    127.9871   495.5875      4.1314    122        Subset Name:
NECK.FRONT     23.0158   362.6609      1.7263    104
NECK.BACK      15.5714    383.462       .5412    110        S5DERMAL.MLOD
UPPER ARMS    157.6735   903.2036      1.4925     90
CHEST          19.0359    263.976      3.4214     90
BACK           10.8933   223.0206      1.8685     89
FOREARMS        4.4266   211.9821       .8927     84
THIGHS         16.6064   198.1742      3.9823     72
LOWER LEGS     37.8101   824.4477      1.1046     82
```

[a] subset criteria included actual and estimated head patches. Of the 122 head observations, 96 were actual and 26 were estimated from nearby patches (Versar, 1992).

Table 5-2. PHED Data from Dermal, Hand, and Inhalation Subsets for Scenario 5[a]

Exposure category	Exposure (µg/lb AI handled)	Replicates in subset	Short-term multiplier[b]	Long-term multiplier[b]
Dermal (non-hand)[c]	433	90[d]	4	1
Hand (with gloves)	58.2	59	4	1
Inhalation	2.35	85	4	1

[a] results from subsets of Mixer/Loader data in the Pesticide Handlers Exposure Database (PHED). Results rounded to three significant figures.

[b] multipliers are explained in the text and in Frank (2007).

[c] dermal total includes addition of default feet value of 0.52 x (value for lower legs); ratio of feet/lower leg surface area (U.S. EPA, 1997).

[d] median number of replicates was used in determining subset multipliers.

Table 5-3. Values in Scenario 5 Exposure Calculations[a]

	Short-term exposure	Long-term exposure
Total Dermal	4(433) + 4(58.2) = 1,960 µg/lb AI handled	1(433) + 1(58.2) = 491 µg/lb AI handled
Inhalation	4(2.35) = 9.40 µg/lb AI handled	1(2.35) = 2.35 µg/lb AI handled

[a] values from Table 5-2. Results rounded to three significant figures

Appendix III-E: Mixer/Loader, Open System, Water Soluble Bags Containing Wettable Powder (*with gloves*)

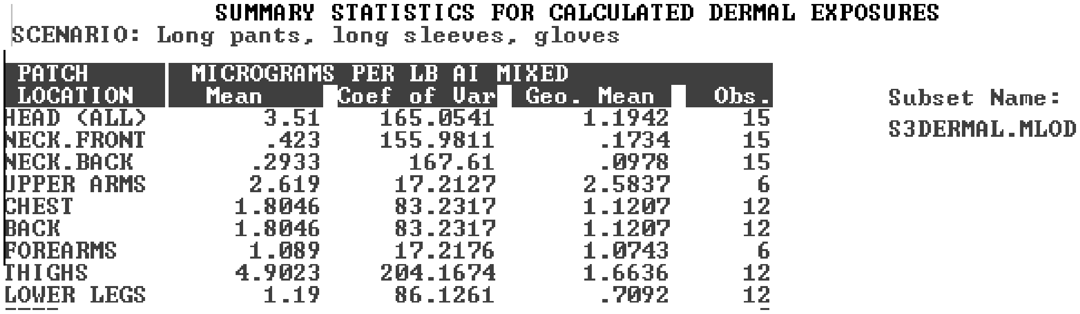
Table 3-1. Description of PHED subsets for Scenario 3[a]

Parameter	Specifications used to generate subsets[a]	Actual characteristics of resulting subsets
Data Quality Grades[b]	A,B	A,B
Solid Type	Wettable powder	Wettable Powder
Package Type	Water Soluble Bag	Water Soluble Bag

[a] subsets of Mixer/Loader data in the Pesticide Handlers Exposure Database (PHED). Parameter descriptions are from screens displayed in the PHED program.

[b] data quality for Dermal Uncovered, Dermal Covered and Hand are all Grade A or B; Airborne data are all Grade A. Data quality grades are defined in the text and in Versar (1992).

Figure 3-1. Summary of Results from the Pesticide Handlers Exposure Database (PHED) Dermal Subset for Scenario 3[a]



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                 SUMMARY STATISTICS FOR CALCULATED DERMAL EXPOSURES
SCENARIO: Long pants, long sleeves, gloves

 PATCH        MICROGRAMS PER LB AI MIXED
 LOCATION      Mean     Coef of Var   Geo. Mean    Obs.           Subset Name:
HEAD (ALL)       3.51     165.0541       1.1942      15           S3DERMAL.MLOD
NECK.FRONT       .423     155.9811        .1734      15
NECK.BACK       .2933       167.61        .0978      15
UPPER ARMS      2.619      17.2127       2.5837       6
CHEST          1.8046      83.2317       1.1207      12
BACK           1.8046      83.2317       1.1207      12
FOREARMS        1.089      17.2176       1.0743       6
THIGHS         4.9023     204.1674       1.6636      12
LOWER LEGS       1.19      86.1261        .7092      12
```

[a] subset criteria included actual and estimated head patches. Of the 15 head observations, all were actual.

Table 3-2. PHED Data from Dermal, Hand, and Inhalation Subsets for Scenario 3[a]

Exposure Category	Exposure (µg/lb AI handled)	Replicates in subset	Short-term multiplier[b]	Long-term multiplier[b]
Dermal (non-hand) [c]	18.3	12[d]	5	2
Hand (with gloves)	0.056	6	9	2
Inhalation	0.277	12	5	2

[a] results from subsets of Mixer/Loader data in the Pesticide Handlers Exposure Database (PHED). Results rounded to three significant figures.

[b] multipliers are explained in the text and in Frank (2007).

[c] dermal total includes addition of default feet value of 0.52 x (value for lower legs); ratio of feet/lower leg surface area (U.S. EPA, 1997).

[d] median number of replicates was used in determining subset multipliers.

Table 3-3. Values Used in Scenario 3 Exposure Calculations[a]

	Short-term exposure	Long-term exposure
Total Dermal	5(18.3) + 9(0.056) = 92.0 µg/lb AI handled	2(18.3) + 2(0.056) = 36.7 µg/lb AI handled
Inhalation	5(0.277) = 1.38 µg/lb AI handled	2(0.277) = 0.554 µg/lb AI handled

[a] values from Table 3-2. Results rounded to three significant figures.

Appendix III-F: Human Flagger, Liquids

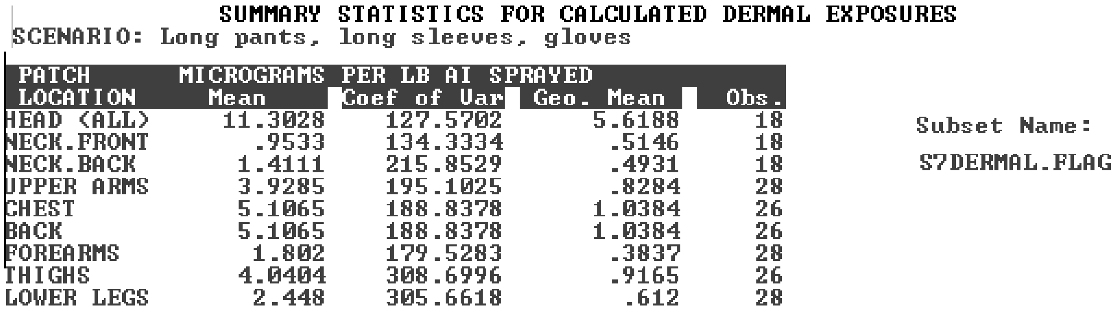
Table 7-1. Description of PHED Subsets for Scenario 7[a]

Parameter	Specifications used to generate subsets[a]	Actual characteristics of resulting subsets
Data Quality Grades[b]	A,B	A,B
Liquid Type or Solid Type	Not specified	Emulsifiable concentrate or dry flowable
Application Method	Fixed- or rotary-wing	All rotary-wing

[a] subsets of Flagger data in the Pesticide Handlers Exposure Database (PHED). Parameter descriptions are from screens displayed in the PHED program.

[b] data quality for Dermal Uncovered and Dermal Covered are all Grade A; Airborne and Hand data are all Grade A or B. Data quality grades are defined in the text and in Versar (1992).

Figure 7-1. Summary of Results from the Pesticide Handlers Exposure Database (PHED) Subset for Scenario 7[a]



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                 SUMMARY STATISTICS FOR CALCULATED DERMAL EXPOSURES
SCENARIO: Long pants, long sleeves, gloves

 PATCH       MICROGRAMS PER LB AI SPRAYED
 LOCATION     Mean     Coef of Var  Geo. Mean    Obs.
HEAD (ALL)   11.3028    127.5702      5.6188      18        Subset Name:
NECK.FRONT     .9533    134.3334       .5146      18
NECK.BACK     1.4111    215.8529       .4931      18        S7DERMAL.FLAG
UPPER ARMS    3.9285    195.1025       .8284      28
CHEST         5.1065    188.8378      1.0384      26
BACK          5.1065    188.8378      1.0384      26
FOREARMS      1.802     179.5283       .3837      28
THIGHS        4.0404    308.6996       .9165      26
LOWER LEGS    2.448     305.6618       .612       28
```

[a] subset criteria included actual and estimated head patches. Of the 18 head observations, all were actual.

Table 7-2. PHED Data from Dermal, Hand, and Inhalation Subsets for Scenario 7[a]

Exposure category	Exposure (µg/lb AI handled)	Replicates in subset	Short-term multiplier[b]	Long-term multiplier[b]
Dermal (non-hand)[c]	37.4	26[d]	4	1
Hand (no gloves)	5.97	30	4	1
Inhalation	0.20	28	4	1

[a] results from subsets of Flagger data in the Pesticide Handlers Exposure Database (PHED). Results rounded to three significant figures.

[b] multipliers are explained in the text and in Frank (2007).

[c] dermal total includes addition of default feet value of 0.52 x (value for lower legs); ratio of feet/lower leg surface area (U.S. EPA, 1997).

[d] median number of replicates was used in determining subset multipliers.

Table 7-3. Values Used in Scenario 7 Exposure Calculations[a]

	Short-term exposure	Long-term exposure
Total Dermal (with gloves)	4(37.4) + 0.4(5.97) = 152 µg/lb AI handled	1(37.4) + 0.1(5.97) = 38.0 µg/lb AI handled
Total Dermal (no gloves)[b]	4(37.4) + 4(5.97) = 173 µg/lb AI handled	1(37.4) + 1(5.97) = 43.4 µg/lb AI handled
Inhalation	4(0.200) = 0.800 µg/lb AI handled	1(0.200) = 0.200 µg/lb AI handled

[a] values from Table 7-2. Results rounded to three significant figures.

[b] gloves assumed to provide 90% protection (Aprea *et al.*, 1994); exposure of gloved hands is calculated as one tenth exposure of bare hands.

Appendix III-G: Low Pressure Handwand Mixer/Loader/Applicator, Wettable Powder Formulations

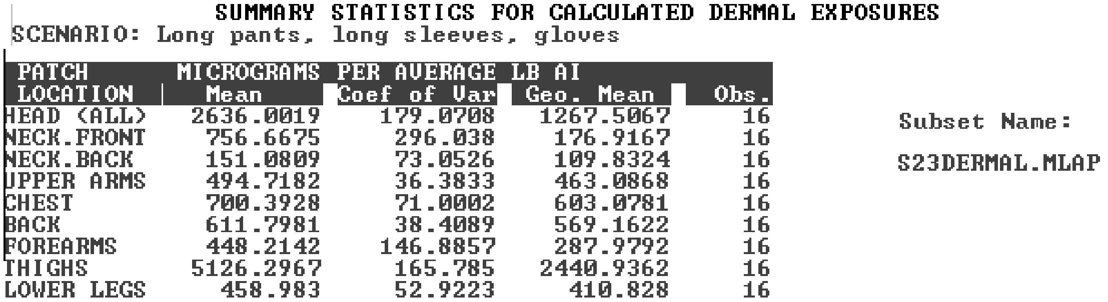
Table 23-1. Description of Pesticide Handlers Exposure Database (PHED) Subsets[a]

Parameter	Specifications used to generate subsets[a]	Actual characteristics of resulting subsets
Data Quality Grades [b]	A,B,C	A,B,C
Solid Type	Wettable powder	Wettable powder
Application Method	Low Pressure Handwand	Low Pressure Handwand
Mixing Procedure	Not specified	All open

[a] subsets of Mixer/Loader/Applicator data in the Pesticide Handlers Exposure Database (PHED). Parameter descriptions are from screens displayed in the PHED program.

[b] data quality for Airborne, Dermal Uncovered, Dermal Covered are all Grade C; Hand data are all Grade A. Data quality grades are defined in the text and in Versar (1992).

Figure 23-1. Summary of results from the PHED dermal subset for Scenario 23[a]



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                    SUMMARY STATISTICS FOR CALCULATED DERMAL EXPOSURES
SCENARIO: Long pants, long sleeves, gloves

 PATCH         MICROGRAMS PER AVERAGE LB AI
 LOCATION  |      Mean     Coef of Var   Geo. Mean     Obs.
HEAD (ALL)    2636.0019      179.0708    1267.5067      16          Subset Name:
NECK.FRONT     756.6675      296.038      176.9167      16
NECK.BACK      151.0809       73.0526     109.8324      16          S23DERMAL.MLAP
UPPER ARMS     494.7182       36.3833     463.0868      16
CHEST          700.3928       71.0002     603.0781      16
BACK           611.7981       38.4089     569.1622      16
FOREARMS       448.2142      146.8857     287.9792      16
THIGHS        5126.2967      165.785     2440.9362      16
LOWER LEGS     458.983        52.9223     410.828       16
```

[a] subset criteria included actual and estimated head patches. Of the 16 head observations, all were actual.

Table 23-2. PHED Data from Dermal, Hand, and Inhalation Subsets for Scenario 23 [a]

Exposure category	Exposure (µg/lb AI handled)	Replicates in subset	Short-term multiplier[b]	Long-term multiplier[b]
Dermal (non-hand) [c]	11,600	16 [d]	5	1
Hand (with gloves)	3,430	15	5	1
Inhalation	1,040	16	5	1

[a] results from subsets of Mixer/Loader/Applicator data in the Pesticide Handlers Exposure Database (PHED). Results rounded to three significant figures.

[b] multipliers are explained in the text and in Frank (2007).

[c] dermal total includes addition of default feet value of 0.52 x (value for lower legs); ratio of feet/lower leg surface area (U.S. EPA, 1997).

[d] median number of replicates was used in determining subset multipliers.

Table 23-3. Values Used in Scenario 23 Exposure Calculations[a]

	Short-term exposure		Long-term exposure	
Total Dermal (with gloves)	5(11,600 + 3,430) =	75,200 µg/lb AI handled	1(11,600 + 3,430) =	15,000 µg/lb AI handled
Total Dermal (no gloves) [b]	5(11,600) + 50(3,430) =	230,000 µg/lb AI handled	1(11,600) + 20(3,430) =	45,900 µg/lb AI handled
Inhalation	5(1,040) =	5,200 µg/lb AI handled	1(1,040) =	1,040 µg/lb AI handled

[a] values from Table 23-2. Results rounded to three significant figures.

[b] gloves assumed to provide 90% protection (Aprea *et al*, 1994); exposure of bare hands is calculated as ten times exposure of gloved hands.

Appendix III-H: High Pressure Handwand Mixer/Loader/Applicator, Liquids (*open pour*)

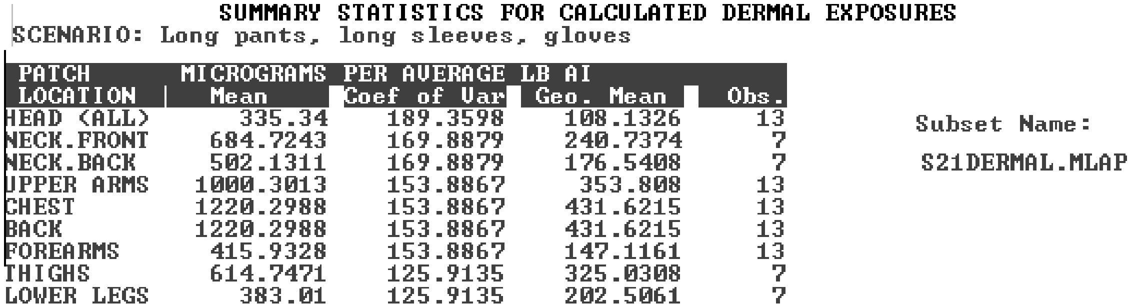
Table 21-1. Description of PHED Subsets for Scenario 21[a]

Parameter	Specifications used to generate subsets[a]	Actual characteristics of resulting subsets
Data Quality Grades[b]	A,B,C	A,B,C
Liquid Type	Not specified	Microencapsulated
Application Method	High pressure hand wand	High Pressure Handwand, Greenhouse/Ornamental
Mixing Procedure	Open	All open

[a] subsets of Mixer/Loader/Applicator data in the Pesticide Handlers Exposure Database (PHED). Parameter descriptions are from screens displayed in the PHED program.

[b] data quality for Airborne, Dermal Uncovered, Dermal Covered are all Grade A; Hand data are all Grade C. Data quality grades are defined in the text and in Versar (1992).

Figure 21-1. Summary of Results from the Pesticide Handlers Exposure Database (PHED) Subset for Scenario 21[a]



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                 SUMMARY STATISTICS FOR CALCULATED DERMAL EXPOSURES
SCENARIO: Long pants, long sleeves, gloves

 PATCH        MICROGRAMS PER AVERAGE LB AI
 LOCATION   |   Mean      Coef of Var  Geo. Mean     Obs.
HEAD (ALL)       335.34     189.3598    108.1326      13          Subset Name:
NECK.FRONT     684.7243     169.8879    240.7374       7
NECK.BACK      502.1311     169.8879    176.5408       7          S21DERMAL.MLAP
UPPER ARMS    1000.3013     153.8867     353.808      13
CHEST         1220.2988     153.8867    431.6215      13
BACK          1220.2988     153.8867    431.6215      13
FOREARMS       415.9328     153.8867    147.1161      13
THIGHS         614.7471     125.9135    325.0308       7
LOWER LEGS       383.01     125.9135    202.5061       7
```

[a] subset criteria included actual and estimated head patches. Of the 80 head observations, 10 were actual and 70 were estimated from nearby patches (Versar, 1992).

Table 21-2. PHED Data from Dermal, Hand, and Inhalation Subsets for Scenario 21[a]

Exposure category	Exposure (µg/lb AI handled)	Replicates in subset	Short-term multiplier[b]	Long-term multiplier[b]
Dermal (non-hand)[c]	6,580	13[d]	5	2
Hand (with gloves)	339	13	5	2
Inhalation	151	13	5	2

[a] results from subsets of Mixer/Loader/Applicator data in the Pesticide Handlers Exposure Database (PHED). Results rounded to three significant figures.

[b] multipliers are explained in the text and in Frank (2007).

[c] dermal total includes addition of default feet value of 0.52 x (value for lower legs); ratio of feet/lower leg surface area (U.S. EPA, 1997).

[d] median number of replicates was used in determining subset multipliers.

Table 21-3. Values Used in Scenario 21 Exposure Calculations[a]

	Short-term exposure		Long-term exposure	
Total Dermal (with gloves)	5(6,580 + 339) =	34,600 µg/lb AI handled	2(6,580 + 339) =	13,800 µg/lb AI handled
Total Dermal (no gloves)[b]	5(6,580) + 50(339) =	49,800 µg/lb AI handled	2(6,580) + 20(339) =	19,900 µg/lb AI handled
Inhalation	5(151) =	755 µg/lb AI handled	2(339) =	302 µg/lb AI handled

[a] values from Table 21-2. Results rounded to three significant figures.

[b] gloves assumed to provide 90% protection (Aprea *et al.*, 1994); exposure of bare hands is calculated as ten times exposure of gloved hands.

Appendix III-I: Backpack Mixer/Loader/Applicator, Liquids (*open pour*)

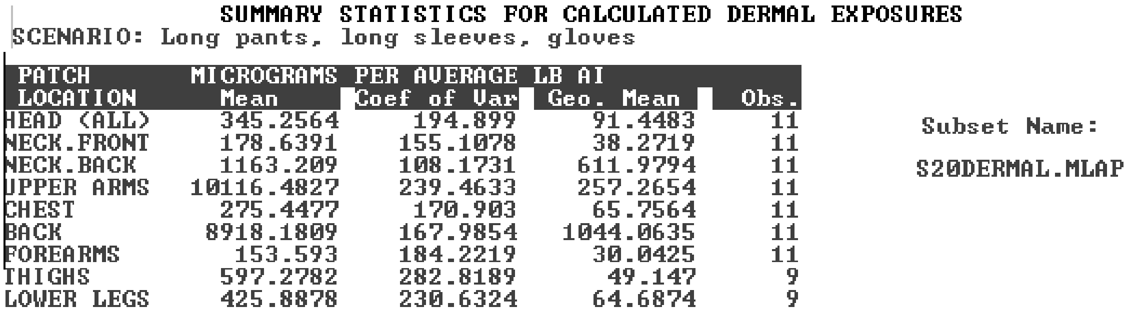
Table 20-1. Description of PHED Subsets for Scenario 20[a]

Parameter	Specifications used to generate subsets[a]	Actual characteristics of resulting subsets
Data Quality Grades[b]	A,B,C	A,B,C
Liquid Type	Not specified	Solution, Microencapsulated
Application Method	Backpack	Backpack
Mixing Procedure	Open	Open

[a] subsets of Mixer/Loader/Applicator data in the Pesticide Handlers Exposure Database (PHED). Parameter descriptions are from screens displayed in the PHED program.

[b] data quality for Airborne, Dermal Uncovered, Dermal Covered are all Grade A or B; Hand data are all Grade C Data quality grades are defined in the text and in Versar (1992).

Figure 20-1. Summary of Results from the Pesticide Handlers Exposure Database (PHED) Subset for Scenario 20[a]



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                SUMMARY STATISTICS FOR CALCULATED DERMAL EXPOSURES
SCENARIO: Long pants, long sleeves, gloves

 PATCH       MICROGRAMS PER AVERAGE LB AI
 LOCATION      Mean     Coef of Var  Geo. Mean    Obs.
HEAD (ALL)    345.2564    194.899     91.4483      11        Subset Name:
NECK.FRONT    178.6391    155.1078    38.2719      11
NECK.BACK     1163.209    108.1731    611.9794     11        S20DERMAL.MLAP
UPPER ARMS  10116.4827    239.4633    257.2654     11
CHEST         275.4477    170.903     65.7564      11
BACK         8918.1809    167.9854   1044.0635     11
FOREARMS      153.593     184.2219    30.0425      11
THIGHS        597.2782    282.8189    49.147        9
LOWER LEGS    425.8878    230.6324    64.6874       9
```

[a] subset criteria included actual and estimated head patches. Of the 11 head observations, all were actual.

Table 20-2. PHED Data from Dermal, Hand, and Inhalation Subsets for Scenario 20[a]

Exposure category	Exposure (µg/lb AI handled)	Replicates in subset	Short-term multiplier[b]	Long-term multiplier[b]
Dermal (non-hand)[c]	22,300	11[d]	6	2
Hand (with gloves)	9.68	11	6	2
Inhalation	17.5	11	6	2

[a] results from subsets of Mixer/Loader/Applicator data in the Pesticide Handlers Exposure Database (PHED). Results rounded to three significant figures.

[b] multipliers are explained in the text and in Frank (2007).

[c] dermal total includes addition of default feet value of 0.52 x (value for lower legs); ratio of feet/lower leg surface area (U.S. EPA, 1997).

[d] median number of replicates was used in determining subset multipliers.

Table 20-3. Values Used in Scenario 20 Exposure Calculations[a]

	Short-Term Exposure		Long-Term Exposure	
Total Dermal (with gloves)	6(22,300 + 9.68) =	134,000 µg/lb AI handled	2(22,300 + 9.68) =	44,600 µg/lb AI handled
Total Dermal (no gloves)[b]	6(22,300) + 60(9.68) =	134,000 µg/lb AI handled	2(22,300) + 20(9.68) =	44,800 µg/lb AI handled
Inhalation	6(17.5) =	105 µg/lb AI handled	2(17.5) =	35.0 µg/lb AI handled

[a] values from Table 20-2. Results rounded to three significant figures.

[b] gloves assumed to provide 90% protection (Aprea *et al.*, 1994); exposure of bare hands is calculated as ten times exposure of gloved hands.

Appendix IV
Use Patterns of Propargite for Handler Exposure Frequencies

The temporal use patterns summarized in Tables IV-A through IV-D below were based on the latest available 2007-2011 annual PUR (Pesticide Use Report) data provided by this Department (DPR, 2013). The PUR data were available by year, month, county, crop/site, poundage, acreage, air *vs*. ground equipment, etc. The following procedures were employed in characterizing the use patterns for the seasonal (high-use) and annual (moderate- and high-use) frequencies for handler exposures. First, the five-year data were separated into air and ground use. The ground-use data from PUR were then separated into those by groundboom, airblast, and handheld equipment; this second step was accomplished by using tree field crops, fruits/nuts, and nursery stock as surrogates, respectively, since the PUR data did not offer details on ground equipment. These self-defined equipment-specific subsets were each then collapsed over the five years by month to yield uses for January through December, with each month being aggregated over the five years. The five-year totals in pounds were used to select the highest-use county, whereas the 12 aggregated monthly uses in pounds were used to determine the high-use periods. For the purpose of this handler exposure assessment, only those aggregated monthly uses reaching five percent (5%) and one percent (1%) of the five-year total were considered as high-use and moderate-use, respectively. (Note that in theory these PUR data used for frequency determination need to be updated with the latest available PUR data, unless the usage and profile on crops treated have changed drastically. This is because the estimates are each intended to represent an average exposure frequency that is far more specific to a particular reentry activity than to the annual usage in a particular year.)

A previous practice at WHS would include monthly uses reaching one percent (1%), instead of five percent (5%) as high-use for annualizing chronic dosage. However, as with many other pesticides, the use of a percentage lower than 5% for cut-point would not be practical with propargite. For airblast and groundboom sprays of propargite in California between 2007 and 2011, 1% amounts to less than 430 lb of AI used for any of the 12 months in any of the five years considered (i.e., for any month between January through December aggregated over five years, as calculated from the percentage of the five-year total footnoted in Table IV-B or IV-C and then divided by five years). This monthly usage of 430 lb equates to 215 acres treated, based on a fair average application rate of 2 lb AI/acre. It also translates to less than 5 workdays per groundboom or airblast applicator for that month, based on the maximum daily acreage of 100 for groundboom or 50 for airblast spray.

Likewise for aerial application of propargite (and more specifically), one percent (1%) of the total usage in the five years amounts to 300 lb per year for any of the 12 months listed in Table IV-A [= (1% of 148,281 lb) x $(5\text{ years})^{-1}$]. This monthly usage equates to roughly 150 acres worth of aerial spray or less, based on a fair average application rate of 2 lb AI per acre. Thus, under the circumstances, the practical percentage for cut-point should be much higher than one percent even for the purpose of annualizing chronic dosage, given that a single aerial application can easily cover 300 acres in one or two days.

The cut-point option of 1% *vs*. 5% was not an issue for mixing/loading/application (M/L/application) with an assumed daily acreage of ≤5, as the monthly usage was either 0% or

>5% in the five years (Table IV-D). In short, it was based on these considerations that 4 months was used as the conservative annual (and seasonal as well) exposure frequency for each of the four handler groups. That is, more or less a period from either May to August or June to September, even though M/L/application apparently did not take place in June.

Table IV-A. Percent Use of Propargite by Air Equipment
in Tulare County, 2007-2011[a]

Month	January	February	March	April	May	June
% Use	0.0	0.0	0.0	0.1	2.9	**16.2**
Month	July	August	September	October	November	December
% Use	**61.8**	**18.9**	0.1	0.0	0.0	0.0

[a] based on all five years of uses listed as using ‘air’ equipment/method in the Pesticide Use Reports (DPR, 2013); months associated with uses in bold are considered as high-use months since their uses each ≥5% of the five-year total usage of 148,281 pounds.

Table IV-B. Percent Use of Propargite via Airblast Equipment
in San Joaquin County, 2007-2011[a]

Month	January	February	March	April	May	June
% Use	0.0	0.0	0.0	0.0	0.1	1.8
Month	July	August	September	October	November	December
% Use	**63.9**	**30.5**	3.5	0.1	0.0	0.0

[a] based on all five years of ground uses on all tree fruits and nuts, including grapes, as listed in the Pesticide Use Reports (DPR, 2013); months associated with uses in bold are considered as high-use months since their uses each ≥5% of the five-year total usage of 202,723 pounds; results were similar with or without grapes.

Table IV-C. Percent Use of Propargite via Groundboom Equipment
in Tulare County, 2007-2011[a]

Month	January	February	March	April	May	June
% Use	0.0	0.1	0.0	0.0	**19.9**	**21.7**
Month	July	August	September	October	November	December
% Use	**48.9**	**9.1**	0.8	0.04	0.0	0.0

[a] based on all five years of ground uses on all crops as listed in the Pesticide Use Reports (DPR, 2013), excluding tree fruits/nuts or nursery type; months associated with uses in bold are considered as high-use months since their uses each ≥5% of the five-year total usage of 210,353 pounds.

Table IV-D: Percent Use of Propargite via Handheld Equipment,
in Kern County, 2007-2011[a]

Month	January	February	March	April	May	June
% Use	0.0	0.0	0.0	0.0	**8.6**	0.0
Month	July	August	September	October	November	December
% Use	**63.8**	**27.6**	0.0	0.0	0.0	0.0

[a] based on all five years of uses on all outdoor and greenhouse nurseries, as listed in the Pesticide Use Reports (DPR, 2013); months associated with uses in bold are considered as high-use months since their uses each ≥5% of the five-year total usage of 1,135 pounds.

Appendix V
Use Patterns of Propargite for Reentry Exposure Frequencies

The temporal use patterns summarized in Tables V-A through V-I below were based on the 2007-2011 annual PUR (Pesticide Use Report) data provided by this Department (DPR, 2013). The PUR data were available by year, month, county, crop/site, poundage, acreage, air *vs*. ground equipment, etc. The following procedures were employed in characterizing the use patterns for the seasonal (high-use) and annual (moderate- and high-use) frequencies for reentry exposures. First, the five-year data were separated into crops or crop groups. The crop-specific data were each then collapsed over the five years by month to yield uses for January through December in terms of amount of *acres* treated, with each month being aggregated over the five years. The five-year totals were used to select the highest-use county, whereas the aggregated monthly uses were used to determine the moderate- or high-use period. The focus here was on acreage, instead of poundage, because it was assumed that reentry frequency depends more on the size of the crop treated than on the pounds handled. For one thing, poundage can be affected by the application rates or number of applications per field used alone. (Note that in theory these PUR data used for frequency determination need to be updated with the latest available PUR data, unless the usage and profile on crops treated have changed drastically. This is because the estimates are each intended to represent an average exposure frequency that is far more specific to a particular reentry activity than to the annual usage in a particular year.)

For this reentry exposure assessment, only those aggregated monthly uses reaching five percent (5%) of the five-year total were considered as high-use months. And those monthly acreages reaching one percent (1%) were included for annualizing chronic dosage. Any cut-point lower than one percent is not considered practical here for propargite because, as footnoted in Table V-A through V-I, one percent of the monthly acreage for crops even with the highest five-year total amounts to less than 140 for that month in each of the five years [e.g., = (1% of 69,036 acres of almonds and walnuts treated in Fresno, from total five-year use on almonds and walnuts) x (5 years)$^{-1}$, *see* Table V-G].

There is an indication (e.g., Blank *et al*., 2011) that it would not take more than 7 weeks to finish harvesting 1,000 acres of walnut (or almond) trees. Based on this harvest rate and the above monthly acreage of 140 calculated from the 1% cut-off, it would require walnut (or almond) harvesters in Fresno to work only 6 or 7 days in a month. Note that most growers want their fruits or crops to be picked and marketed at the earliest possible time to avoid any unnecessary loss of production. Therefore, it is simply not appropriate to include any month that involves only a few workdays for the purpose of annualizing chronic exposure.

Table V-A. Percent Use of Propargite on Cotton,
in Kings County, 2007-2011[a]

Month	January	February	March	April	May	June
% Use	0.0	0.0	0.0	0.0	1.5	0.5
Month	July	August	September	October	November	December
% Use	**19.3**	**65.8**	**12.9**	0.0	0.0	0.0

[a] based on all five years of uses on cotton, as listed in the Pesticide Use Reports (DPR, 2013); months associated with uses in bold are considered as high-use months since their uses each ≥5% of the five-year total of 6,943 acres treated (via aerial or ground application).

Table V-B. Percent Use of Propargite on Grapes,
in Fresno County, 2007-2011[a]

Month	January	February	March	April	May	June
% Use	0.0	0.0	0.0	0.0	**5.2**	**41.9**
Month	July	August	September	October	November	December
% Use	**46.0**	**7.0**	0.0	0.0	0.0	0.0

[a] based on all five years of uses on grapes (all, both wine and non-wine), as listed in the Pesticide Use Reports (DPR, 2013); months associated with uses in bold are considered as high-use months since their uses each ≥5% of the five-year total of 14,209 acres treated (via aerial or ground application); note that San Joaquin County had a slightly higher five-year total of 14,269 acres treated, but with only June (6.4%), July (74.8%), and August (18.3%) being the high-use months.

Table V-C. Percent Use of Propargite on Stone Fruits,
in San Joaquin County, 2007-2011[a]

Month	January	February	March	April	May	June
% Use	0.0	0.0	0.0	0.0	0.0	0.6
Month	July	August	September	October	November	December
% Use	**26.6**	**54.3**	**17.0**	1.5	0.0	0.0

[a] based on all five years of uses on all stone fruits (primarily nectarines), as listed in the Pesticide Use Reports (DPR, 2013); months associated with uses in bold are considered as high-use months since their uses each ≥5% of the five-year total of 11,201 acres treated (via aerial or ground application).

Table V-D. Percent Use of Propargite on Citrus,
in Tulare County, 2007-2011[a]

Month	January	February	March	April	May	June
% Use	0.0	0.0	0.0	**59.6**	**40.4**	0.0
Month	July	August	September	October	November	December
% Use	0.0	0.0	0.0	0.0	0.0	0.0

[a] based on all five years of uses on oranges, grapefruit, lemons, limes, tangerines, as listed in the Pesticide Use Reports (DPR, 2013); months associated with uses in bold are considered as high-use months since their uses each ≥5% of the five-year total of (only) 99 acres treated (via aerial or ground application); note that during 2000-2004, the county also had the highest five-year total of 1,583 acres treated, with April (44.8%), May (45.5%), and June (8.4%) being the high-use months.

Table V-E. Percent Use of Propargite on Outdoor Nurseries,
in Kern County, 2007-2011[a]

Month	January	February	March	April	May	June
% Use	0.0	0.0	0.0	0.0	**14.9**	**20.6**
Month	July	August	September	October	November	December
% Use	**43.2**	**20.0**	1.3	0.0	0.0	0.0

[a] based on all five years of uses on all outdoor nurseries, as listed in the Pesticide Use Reports (DPR, 2013); months associated with uses in bold are considered as high-use months since their uses each ≥5% of the five-year total of 1,983 acres treated (via aerial or ground application).

Table V-F. Percent Use of Propargite on Mints and Other Herbs,
in Shasta County, 2007-2011[a]

Month	January	February	March	April	May	June
% Use	0.0	0.0	0.0	0.0	0.0	**16.6**
Month	July	August	September	October	November	December
% Use	**72.1**	**11.4**	0.0	0.0	0.0	0.0

[a] based on all five years of uses on mint and other herbs, as listed in the Pesticide Use Reports (DPR, 2013); months associated with uses in bold are considered as high-use months since their uses each ≥5% of the five-year total of 4,229 acres treated (via aerial or ground application).

Table V-G. Percent Use of Propargite on Almonds and Walnuts,
in Fresno County, 2007-2011[a]

Month	January	February	March	April	May	June
% Use	0.0	0.0	0.0	0.0	2.0	**21.1**
Month	July	August	September	October	November	December
% Use	**52.5**	**20.0**	4.4	0.0	0.0	0.0

[a] based on all five years of uses on almonds and walnuts, as listed in the Pesticide Use Reports (DPR, 2013); months associated with uses in bold are considered as high-use months since their uses each ≥5% of the five-year total of 62,179 acres treated (via aerial or ground application); note that San Joaquin had the highest five-year total of 69,036 acres treated, but with only July (64.5%) and August (31.5%) being the high-use months.

Table V-H. Percent Use of Propargite on Corn,
in Fresno County, 2007-2011[a]

Month	January	February	March	April	May	June
% Use	0.0	0.0	0.0	1.5	**36.7**	**22.6**
Month	July	August	September	October	November	December
% Use	**19.6**	**10.8**	**8.8**	0.0	0.0	0.0

[a] based on all five years of uses on corn for human consumption, as listed in the Pesticide Use Reports (DPR, 2013); months associated with uses in bold are considered as high-use months since their uses each ≥5% of the five-year total of 15,528 acres treated (via aerial or ground application).

Table V-I. Percent Use of Propargite on Beans,
in Sutter County, 2007-2011[a]

Month	January	February	March	April	May	June
% Use	0.0	0.0	0.0	0.0	0.0	1.4
Month	July	August	September	October	November	December
% Use	**54.2**	**36.8**	**7.6**	0.0	0.0	0.0

[a] based on all five years of uses on all types of beans, as listed in the Pesticide Use Reports (DPR, 2013); months associated with uses in bold are considered as high-use months since their uses each ≥5% of the five-year total of 8,823 acres treated (via aerial or ground application).

Appendix VI
Calculation of Dermal Concentrations on Propargite Workers

1. Potential Need for Calculation

In this document, and in some other WHS assessment documents as well (e.g., Dong and Haskell, 2000), dermal *concentration* is referred to as the amount of pesticide residues present *on* a worker’s skin surface, and is typically expressed as μg of residues per cm^2 of the surface area considered. In essence, this is the dermal dose that, while not yet absorbed into the skin, could potentially induce a localized skin effect such as skin irritation. As mentioned in the Exposure Appraisal, there is a potential need for calculating the dermal concentrations (doses) for workers considered in this assessment in that propargite is known for its skin irritation potential. It should also be pointed out that the dermal doses calculated for subchronic exposures may be used for chronic exposures. However, chronic dermal doses are typically not considered, and hence were not amortized in this assessment, because skin irritation type localized effects are rarely caused by a low dose in a prolonged period involved in what constitutes a long-term exposure.

2. Algorithm and Assumptions Used

In Tables 10 through 12 for acute (short-term), and Tables 13 through 15 for subchronic, where *handler* exposures were considered in Section V, the body surface areas from PHED were used for the individual body regions because all of the dermal exposure rates used in the handler exposure assessment were from PHED. In contrast, the surface areas used in Tables 19 and 20, where acute and subchronic *reentry* exposures were considered (respectively), were based on default values adopted for female workers as they have smaller body surface areas compared to their male counterparts and their involvement in reentry activities is more than occasional. Note that as illustrated in the algorithm presented later on, the use of a *smaller* body surface would yield a *higher* dermal concentration. Currently the default values used for female workers are 85% of those used by PHED. The 85% factor came from the fact that the total (male) body surface assumed by PHED is 21,110 cm^2, whereas the total female body surface used by WHS (e.g., Dong and Haskell, 2000) is 18,000 cm^2; that is, 85% = 18,000 cm^2/21,110 cm^2. The total female surface of 18,000 cm^2 is actually on the high end in reference to the data provided by U.S. EPA (1997), but nonetheless is consistent with the likewise high-end total body surface of 21,110 cm^2 used predominately for male workers in the PHED subsets.

Here unabsorbed dermal doses were calculated for *all* critical body regions (BRs), or body parts, because *localized* skin effects are of potential concern and because in general different BRs receive different levels of exposure depending on the task or activity involved. The PHED database provides the dermal exposure rates (e.g., μg dermal residues per pound of active ingredient handled) for the individual BR (e.g., as listed in Appendix III). To facilitate the presentation and discussion, these dermal exposure rates for the individual BRs, along with their individual surface areas, are reproduced in Tables 10 through 15. To back calculate the handler dermal dose in μg/cm^2 from the *absorbed* daily dosages (ADD) listed in Tables 7 through 9 given in the main text, the following algorithm was used.

Dose (*BR*) = [(*portion* of total dermal exposure attributed to the BR in question) x (ADD) x (dermal absorption used)$^{-1}$ x (body weight used)] x (surface area of BR)$^{-1}$.

Examples are footnoted in Tables 10 through 15 for use of the above algorithm to back calculate the handler dermal doses in question.

For *fieldworkers*, the portion of total dermal exposure attributed to a specific BR (body region) was determined using the *ratio* of the body surface area for that region to the whole body surface area that may or may not include the hand region, depending on the reentry activity involved. Such a ratio was used because the assumption was that in most reentry cases, all non-hand body parts contribute equally to the total non-hand dermal exposure. It was also assumed that in these cases, the hand region alone contributes roughly 85% of the whole body dermal as so warranted by and evident from most reentry activities. The two exceptions here are cotton/corn scouts and grape girdlers, for which all body regions *including the hand* were assumed to contribute equally, as field observations suggested that upon reentry all of their body parts are likely to come in contact with foliar residues in more or less equal frequency and intensity. In all reentry cases considered in this assessment, the hand region included the forearm because the foliar contacts of these two body parts are almost inseparable for most of the reentry activities involved.

Note that several adjustment factors should have been included in the calculations here, but partly for simplicity were omitted because their effects on the calculations collectively and roughly cancelled one another out. Another more subtle reason for not considering these adjustment factors separately is that they cannot be quantified easily. These adjustment factors included, but were not limited to:

1. Eight (8) work hours were assumed here compared to the fewer (e.g., 6) test hours per day typically used in a rat dermal toxicity study, thus yielding an apparent substantial excess (e.g., 33%) of worker exposure;

2. Half of the 8 hourly worker dermal exposures would be acquired during the second half of the workday and hence would last less than 4 hours long (i.e., an issue of bolus *vs*. incremental dosing);

3. Workers might not take a shower or bath to wash the residues off their skin until a couple of hours after work, thus prolonging the daily exposure duration;

4. Certain fraction of the pesticide residues that have been deposited onto the worker's skin or clothing will be dislodged off simply due to the worker's field activity, whereas occlusion of pesticide on the rat skin in a (typical) dermal toxicity study will increase the irritation on the animal skin.