Office of Prevention, Pesticides, and Toxic Substances

Environmental Fate and Ecological Risk Assessment for the Registration of **Iodomethane** *(Methyl Iodide)*

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I. ENVIRONMENTAL RISK CONCLUSIONS

Iodomethane is a short-lived chemical in the lower atmosphere and unlikely to reach the upper atmosphere to deplete the ozone layer. The estimated maximum concentration of iodomethane in air appears unlikely to pose an acute risk to birds and mammals. Short-term inhalation exposures of iodomethane are unlikely to pose chronic risk to birds and mammals. It also appears that no adverse effect on aquatic invertebrates or fish are likely because of low potential of runoff to the surface water bodies from the tarped post application sites of iodomethane. The environmental fate data, the residual contents in soils, and Tier I and II models estimated concentrations suggest that the adverse effect on ground water or surface water is highly unlikely due to iodomethane use.

Iodomethane is proposed for use as an alternative pre-plant fumigant for methyl bromide in fields to be planted to tomatoes, strawberries, peppers, select ornamentals, turf, and re-plants of trees and vines. Low affinity for sorption into the soil (K_{oc} 34.8 L Kg^{-1})and high vapor pressure (405.9 mm Hg) of iodomethane suggest that volatilization of iodomethane is the major route of dissipation. Available data indicate that there is 54 to 80% dissipation to the air even before the tarpaulin is removed. Once it volatilized, iodomethane degrades rapidly in the lower atmosphere via direct photolysis and lasts in the atmosphere less than twelve days, as compared with two years for methyl bromide. Therefore, iodomethane is unlikely to reach upper atmosphere to impact ozone layer. The estimated ozone depletion potential (ODP) for iodomethane is 0.029 as compared to 0.65 for methyl bromide. However, global uncertainty on volatilization rates, residence time in soil, photolytic degradation of iodomethane, and the removal of iodine radicals from troposphere means that the possibility of detrimental effects of iodomethane on ozone layer and a contribution to global warming can not be excluded.

The primary route of iodomethane exposure of nontarget terrestrial animals will be inhalation. Direct flux of iodomethane in air was estimated using the Industrial Source Complex (ISC) dispersion model and monitoring data from iodomethane treated field. The estimated maximum concentration of iodomethane (0.987 ppm) at 242 lbs a.i./acre appears unlikely to pose an acute risk to birds and mammals (the maximum proposed application rate is 235 lbs a.i./acre). Iodomethane is a short-lived chemical in the atmosphere. Therefore, there is low potential for chronic risk to birds and mammals. It also appears that no adverse effect on aquatic invertebrates or fish are likely because of low potential to runoff from the tarped post application sites of iodomethane to the surface water bodies. Based upon Tier II PRZM/EXAMS estimated environmental concentrations (EECs) for surface water, no Levels-of-Concern (LOCs) for aquatic invertebrates or fish are exceeded. EFED also believes that the Henry's Law Constant of 5.23E-03atm-m^3/mole (highly soluble and volatile) of iodomethane suggest that chronic exposures to the aquatic invertebrates and fish are not likely to occur.

EFED is uncertain regarding the effects of this fumigant to terrestrial and semi-aquatic plants as well as aquatic plants. Tier I and Tier II plant data will enable EFED to complete the risk assessment of plants. However, based in part on a prior draft of a biological opinion from the United States Fish and Wildlife Service (USFWS) for tarped uses of methyl bromide, the Field and External Affairs

Division (FEAD) does not presently have a concern for the proposed tarped uses of iodomethane and endangered species, including endangered plants.

Based on environmental fate data, the residual contents in soils, and Tier I and II models estimated concentrations, EFED does not expect iodomethane to adversely impact ground water or surface water. Tier II PRZM/EXAMS for surface water and Tier I SCIGROW for ground water were used to estimate iodomethane concentrations. These concentrations are in nanograms per liter (ng/L), or parts per trillion. However, since this compound is very soluble in water, there is the possibility of leaching to ground water, if slicing or removal of the tarpaulin coincides with, or is followed soon by, a rain event. EFED recommends adding cautionary language to the label to prohibit the slicing or removal of the tarpaulin if it is raining or if rain is expected within 48 hours.

II. INTRODUCTION

Methyl bromide is used extensively on a global basis as a pesticide against nematodes, weeds, insects, fungi, bacteria, and rodents. However, methyl bromide has been identified as a significant ozone depleting substance, resulting in regulatory actions being taken by the U.S. Environmental Protection Agency and by the United Nations Environment Program (Montreal Protocol). Iodomethane is proposed for use as an alternative pre-plant fumigant for methyl bromide in fields to be planted to tomatoes, strawberries, peppers, select ornamentals, turf, and re-plants of trees and vines. It is formulated as a 98% active ingredient (a.i.) product (TM-42501) with 2% chloropicrin as a "warning odorant", and a 25% a.i. product (TM-42503) with 75% chloropicrin as an active ingredient. The mode of action of monohalomethanes (chloride, bromide, iodide substituted) is still not well understood. The iodide ion concentration is insufficient to explain iodomethane toxicity. Toxicologic and metabolic similarities among the monohalomethanes suggest a common mechanism of toxic action, probably methylation and disturbance or inactivation of essential proteins.

III. INTEGRATED ENVIRONMENTAL RISK CHARACTERIZATION

Iodomethane, an alternative fumigant to methyl bromide, is a short-lived chemical in the lower atmosphere and unlikely reach the upper atmosphere to deplete the ozone layer. The environmental fate data, the residual contents in soils, and Tier I- and II model- estimated concentrations suggest that the adverse effect on ground water or surface water is highly unlikely due to iodomethane use. The estimated maximum concentration of iodomethane in air appears unlikely to pose an acute risk to birds and mammals. Short-term inhalation exposures of iodomethane are unlikely to pose chronic risk to birds and mammals. It also appears that no adverse effect on aquatic invertebrates or fish are likely because of low potential to runoff from the tarped post application sites of iodomethane to the surface water bodies.

The high vapor pressure of 405.9 mm Hg at 25°C and Henry's Law constant of 5.23E-03atm-m^3/mole and low affinity for sorption on soil (K_{oc} 34.8 L Kg^{-1}) of iodomethane suggest that volatilization is the most important environmental route of dissipation. Field data from the applied iodomethane via broadcast shank injection in the bare-ground plot and followed simultaneously with a standard 1 mil plastic tarpaulin over the treated plot suggest that 54 to 80 percent of iodomethane was dissipated to the atmosphere even before the tarpaulin is removed. Once volatilized into the atmosphere, it degrades rapidly due to direct photolysis and the estimated atmospheric residence time is less than 12 days. The estimated ODP iodomethane is less than 0.029, well below the level of Class I ozone depleters. Under Title VI, Section 602 of the Clean Air Act, the US Environmental Protection Agency classified any substance with an ODP 0.20 or greater as a Class 1 ozone depleting substance. However, global uncertainty on volatilization rates, residence time in soil, photolytic degradation of iodomethane, and the removal of iodine radicals from troposphere means that the possibility of detrimental effects of iodomethane on ozone layer and a contribution to global warming can not be excluded.

Field dissipation data suggest that applied iodomethane was more confined to the soil layers adjacent to the 30-cm depth of iodomehane placement than the soil layers below 60 cm depth. No residual iodomethane was detected at the end of the field study period (90 days) at either site. Even if any iodomethane exposure should occur in the surface water, Henry's Law constant of 5.23E-03atm-m^3/mole suggests rapid volatilization of iodomethane to atmosphere. Tier II PRZM/EXAMS for surface water and Tier I SCIGROW for ground water were used to estimate iodomethane concentrations. These concentrations are in nanograms per liter (ng/L), or parts per trillion. Based on environmental fate, the residual contents in soils, and Tier I and II models estimated concentrations, EFED does not expect iodomethane to adversely impact ground water or surface water.

Iodomethane's use as a pre-plant fumigant is not expected to pose a substantial direct risk to nontarget terrestrial or aquatic wildlife. It appears that the primary route of exposure of nontarget terrestrial organisms will be inhalation. Direct flux of iodomethane in air was estimated using the Industrial Source Complex (ISC) dispersion model and monitoring data from iodomethane treated field. Estimated data indicate that air concentrations of up to 0.987 ppm (at 30cm above the tarped ground at 8 - 19 hours post-application). Since the available avian acute inhalation LC50 is 395 ppm (over 400X this peak estimated residue), there does not appear to be a substantial risk of acute lethality to birds, even if they do fly above or land on the tarpaulin on the day of application. Birds off-site would be exposed to even lower residues and potential risk.

It appears that mammals are less acutely sensitive than birds to iodomethane (LC50 equivalent to 689 ppm). The HED recommended endpoint for human health risk assessment is an inhalation maternal NOAEL of 10 ppm in a developmental toxicity study, where rabbits were exposed for six hours/day for 23 days. The peak estimated short-term residues above the tarp (0.987 ppm) are below even this NOAEL from a 23-day study. Off-site or long-term residues and risk would be even lower.

EFED does not consider iodomethane to pose an acute or chronic risk to fish and aquatic invertebrates because of low potential to runoff from the tarped post application sites of iodomethane to the surface water bodies. The low octanol/water partition coefficient (log $K_{ow} \leq 1.69$) indicates that iodomethane is not likely to be bioconcentrated in tissues of aquatic organisms. The highest acute aquatic EEC for the iodomethane ecological risk assessment is 0.942 ppb, for Florida peppers. Comparing this value to the acute toxicity value (LC_{50}) for the most sensitive test species (*D. magna*, 570 ppb) produces a maximum risk quotient of 0.0017. This is well below the lowest acute aquatic Level-of-Concern (LOC) of 0.05 (endangered species). EFED also believes that the Henry's Law Constant of 5.23E-03atm-m^3/mole (highly soluble and volatile) of iodomethane suggest that chronic exposures to the aquatic invertebrates and fish are not likely to occur.

IV. ENVIRONMENTAL FATE ASSESSMENT

(A) Physicochemical Properties

Table 1 presents the important physical and chemical properties of iodomethane. The vapor pressure and Henry's Law constant are high, suggesting that volatilization is the most important environmental route of dissipation. Field volatilization studies (MRID 45593710 and 45593822) suggest that the concentrations of iodomethane in the fumigated areas were significantly higher than the atmospheric background level (0.12 μg m^{-3} or 0.02 ppbv) during the 10-day monitoring period. Cumulative volatilization losses of iodomethane ranged from 54 to 94 percent within 10 days. The low octanol/water partition coefficient indicates that iodomethane is not likely to be bioconcentrated in tissues of aquatic organisms.

Table 1. Physico-chemical and environmental fate properties of iodomethane.

Parameter	Values and Units	Sources
	Physical and Chemical Properties	
Chemical Name	Iodomethane (Methyl Iodide, CH_3I)	CAS No.74-88-4
Molecular weight	141.94 g/Mol	MRID 45593705
Water solubility	1420 mg/L at 25°C	MRID 45593705
Specific gravity	2.8 at 20°C	Product Chemistry
Vapor pressure	405.9 mm Hg at 25°C	Product Chemistry
Henry's law constant	5.23E-03atm-m^3/mole	www.toxnet.nlm.nil.gov
UV absorption	Maximum (2.5 absorbance units) at *ca.* 200 nm, with a smaller peak (0.25 au) at *ca.* 250 nm	MRID 45593706
Octanol/Water partition coefficient (log K_{ow})	1.51-1.69	International Occupational Safety and Health Information Centre
Melting point	-66.5°C	International Occupational Safety and Health Information Centre
Boiling point	42.4°C	Product Chemistry
	Environmental Fate Properties	
Hydrolysis Half-Life @		MRID 45593705
pH 4 @ 25°C	105 days	
pH 7 @ 25°C	94 days	
pH 9 @ 25°C	108 days	
Hydrolysis Half-Life @		
pH 4 @ 50°C	3.4 days	
pH 7 @ 50°C	2.5 days	
	2.6 day	

Table 1. Physico-chemical and environmental fate properties of iodomethane.

Parameter	Values and Units	Sources
pH 9 @ 50°C		
Aerobic Soil Metabolism $t_{½}$,	2 hours (short half-life resulted due to volatilization of iodomethane)	MRID 45593707
Anaerobic Soil Metabolism $t_{½}$,	38 hours (Sediment only)	MRID 45593708
Aerobic Aquatic Metabolism $t_{½}$,	39 hours (Water only)	MRID 45593708
Anaerobic Aquatic Metabolism $t_{½}$,	40 hours (Whole system)	MRID 45593708
Direct photolysis (atmosphere)	11.5 days[1]	D. Wuebbles, University of Illinois (personal communication, 2002)
Direct Aqueous Photolysis	13 days	MRID 45593706
Soil Water Partition Coefficient (K_{oc}) (Mean of five soils)	34.8 L Kg^{-1} (SD ±16.8)	MRID 45593709

[1]Atmospheric model-estimated lifetime based on emissions globally distributed; lifetime will vary with location of emissions

Conversion Factors

To convert concentrations in air (at 25 °C) from ppm to mg/m^3: mg/m^3 = (ppm) ×(molecular weight of the compound)/(24.45). For methyl iodide: 1 ppm = 5.81 mg/m^3.

To convert concentrations in air from $\mu g/m^3$ to mg/m^3: mg/m^3 = ($\mu g/m^3$) × (1 mg/1,000 µg).

(B) Fate and Transport in soil and water

The environmental fate data for iodomethane are also presented in Table 1. The rapid dissipation of iodomethane in both the aerobic soil (MRID 45593707) and anaerobic aquatic (MRID 45593708) conditions is primarily the result of volatilization rather than microbial degradation. However, carbon dioxide was detected in both studies. It gradually increased to 1.1 percent of the total applied radioactivity by the end of the aerobic soil study and to 2.5 percent of the total applied radioactivity by the end of the anaerobic aquatic study. This indicates that limited microbial degradation of iodomethane may have affected soil aerobic and anaerobic metabolisms. Iodomethane was hydrolyzed slowly (94 to 108 days) in acidic, neutral, and alkaline conditions at ambient temperature yielding 16 to 18 percent of methanol (MRID 45593705). Photolysis occurs both in gas and solution phases. The aqueous photolysis half-life for iodomethane in the irradiated solution was 13 days, based on the continuous irradiation used in the laboratory study (MRID 40593706). The major transformation products of aqueous photolysis were methanol and formaldehyde, which increased steadily to maximum concentrations of 18.7% and 36.5% respectively, after 15 days of irradiation. In batch equilibrium studies (MRID 45593709), iodomethane shows low absorption potential in five soils tested. The calculated $K_{OC,\ ads}$

values ranged from 15-59 L Kg^{-1} suggest that it has a high mobility in soil. In the field dissipation study (MRID 45593711), maximum iodomethane concentrations were 4.157 mg a.i./kg (1.3 days) in the 15-30 cm soil depth, 2.677 mg a.i./kg (4 days) in the 30-45 cm soil depth, and 0.442 mg a.i./kg (4 days) in the 107-122 cm soil depth in California. Following the removal of tarpaulin, the plots were aerated through chiseling to facilitate the volatilization of residual iodomethane. The concentration of iodomethane below 122 cm was negligible (0.011 a.i./kg) at day 8 post-treatment. At the Florida site, maximum iodomethane concentrations were 10.785 mg a.i./kg (0.3 days) in the 30-45 cm soil depth, 8.461 mg a.i./kg (1 day) in the 45-61 cm soil depth, and 0.209 mg a.i./kg (14 days) in the 107-122 cm soil depth. Iodomethane was not detected at the end of the study period (90 days). Field dissipation data suggest that applied iodomethane was more confined to the layers adjacent to the 30 cm depth of iodomethane placement than soil layers below 60 cm. However, since this compound is soluble in water, there is the possibility of leaching through soil profile into ground water if removal or slicing of the tarpaulin coincides with, or is followed soon by, a rain event.

(C) ***Fate and Transport in atmosphere***

Two field volatilization studies (MRID 45593710 and 45593822) were conducted using iodomethane, which was applied via broadcast shank injection in the bare-ground plot and followed simultaneously with a standard 1 mil plastic tarpaulin over the treated plot. The volatilization of iodomethane (MRID 45593710; methyl iodide; TM-425; technical; analytical purity 99.7%) was determined under field conditions on a sandy loam soil (41.6% sand content) in Watsonville, California and on a loamy sand
(sand content 88.0%) soil in Dover, Florida. The sampling intervals for the study were inadequate to accurately establish the half-life of the test substance (> 50% of the test material degraded between the initial sample at day 0 and the second sample on day 1).

Table 2. Time weighted average iodomethane (TM 425) residue at selected above ground heights in the center of the treated field in Manteca, California.

Period	Air Concentrations (ppbv)			
	15 cm	30 cm	80 cm	150 cm
0-3 hours	1073	648	229	170
3-6 hours	1373	905	381	116
6-8 hours	2479	1225	277	42
8-19 hours	NA	NA	NA	NA
Day 1	449	239	96	43
Day 2	139	73	32	13
Day 3	69	53	19	9
Day 4	113	92	38	17
Day 7	30	14	9	6

Day 10	8	4	1	1

NA = Not available

Another field volatility study was conducted in a bareground plot of low organic matter containing sandy soil (sand content 91.0%) located in Manteca, California (MRID 45593822).This study includes more frequent sampling intervals in the first 8 hours and the total mass of iodomethane lost from the soil was 94% of the applied (554 lb or 251 kg;) after 10 days. The greatest mass loss, 21%, occurred during the first three hours of application, while a mass loss of 41% occurred within the first 24 hours, and a 62% mass loss occurred within the first 2 days following application. Rapid diffusions of applied iodomethane through the tarpaulin suggest that the effectiveness of the tarpaulin to contain the applied fumigant may have been compromised. There was a slight increase in volatilization when the tarpaulin was cut open at day 4, but the recorded concentrations of iodomethane were well below the concentration on the application day. Table 2 shows the time-weighted average of iodomethane level at the center of the treated plot at various heights from the ground surface. These monitoring data in conjunction with time-averaged profiles of wind speed and air temperature were used to calculate the direct flux of iodomethane using ISC dispersion model. Flux rate decreased from 481 μg/m^2-s during the 3-hours following application, to 276 μg/m^2-s at 3-6 hours, 87 μg/m^2-s at 6-8 hours, and 48 μg/m^2-sec at 8-19 hours on the application day (Table 3). In the first 12 hours of day 1 (daytime), flux rate had increased to 115 μg/m^2-sec, before decreasing to 17 μg/m^2-sec at 12-24 hours (nighttime) of day 1. Results suggest that volatilization of iodomethane exhibited diurnal fluctuation, with daytime period flux rates greater than nighttime period flux rates.

Table 3 also presents the estimated iodomethane air concentrations at two different heights from the ground surface at the center of the fumigated field in California. At a height of 30 cm, the estimated concentration of iodomethane in air was 921 ppbv (5345 μg/m^3) in the first 3 hours after application, 607 ppbv at 3-6 hours, 987 ppbv at 8 to 19 hours, an average of 347 on day 1, and 12 ppbv on day 10. At a height of 80 cm, the concentration of iodomethane in air was 453 ppbv in the first 3 hours after application, 266 ppbv at 3-6 hours, 182 ppbv at 8 to 19 hours, an average of 102 ppbv on day 1, and 5 ppbv on day 10.

Table 3. Estimated direct flux and air concentrations of Iodomethane (TM 425) at selected above ground heights in the center of the treated field in Manteca, California.

Period	Direct Flux (μg/m^2-s)	Air Concentrations (ppbv)	
		30 cm	80 cm
Day 0, 0-3 hours	481	921	453
Day 0, 3-6 hours	276	607	266
Day 0, 6-8 hours	87	927	391

Table 3. Estimated direct flux and air concentrations of Iodomethane (TM 425) at selected above ground heights in the center of the treated field in Manteca, California.

Period	Direct Flux (µg/m^2-s)	Air Concentrations (ppbv)	
		30 cm	80 cm
Day 0, 8-19 hours	48	987	182
Day 1, 0-12 hours	115	228	85
Day 1, 12 24 hours	17	465	118
Day 2, 0-12 hours	34	72	27
Day 2, 12 24 hours	6	75	20
Day 3, 0-12 hours	19	42	17
Day 3, 12 24 hours	7	190	42
Day 4, 0-12 hours	32	83	40
Day 4, 12 24 hours	5	157	34
Day 10, 0-12 hours	3	4.3	2
Day 10, 12 24 hours	3	20	8

(D) Persistence

The distribution and lifetime of CH_3I in the atmosphere is a factor of the rate of emission and removal, and is important for determining the build-up of the chemical in the atmosphere. To determine the atmospheric lifetime of CH_3I, estimates of removal [UV absorption cross-section and reaction rate constant of hydroxl (OH)] were obtained from other studies (MRID 45593712). Assuming evenly distributed flux of CH_3I with latitude, Don Wuebbles and colleagues at the University of Illinois obtained a model-calculated atmospheric lifetime for iodomethane of 11.5 days. The derived atmospheric lifetime will depend on where emissions occur, with a shorter lifetime derived for emissions in the tropics and a longer lifetime for emissions at high latitudes (Don Wuebbles, Personal communication, 2002). Atkinson et al. (1997) reported that iodomethane will degrade in atmosphere through direct photolysis process, with a lifetime of 2.8 to 5.5 days, but this is based on a crude approach to estimating the atmospheric lifetime for such a short-lived gas (Wuebbles et al., 2001). Iodomethane will be also photolyzed at slower rates with the hydroxyl (OH) radical with roughly an atmospheric half-life of about 117 to 220 days, based on atmospheric average concentration of OH radicals (Brown et al., 1990 and Atkinson et al., 1997). Again, actual lifetime will depend on location of the emissions for such a short-lived gas.

As a substance with a short atmospheric lifetime, iodomethane falls into the same category as n-propyl bromide which has an atmospheric lifetime of 19 days. *The Montreal Protocol on Substances that Deplete the Ozone Layer* to date has not called for the regulation or phase out of these substances. In turn, the EPA under its authority under the Clean Air Act has chosen to allow the production, import, and use of these substances. However, there is a disparity in the atmospheric lifetimes, and therefore ozone depletion potential, of these substances depending on where they are emitted. The impacts of short-lived substances emitted from the tropical latitudes, which happens to be the general location of developing countries, may actually prove to be consequential. In such an event, it is not clear that the Parties to the Montreal Protocol would require that a stricter set of rules apply to developing countries than to developed ones. Thus, even short-lived compounds that have minimal impact when emitted from the U.S., could be phased out due to policy considerations by the Parties.

(E) Monitoring Data (Air)

The United States Environmental Protection Agency has compiled ambient air monitoring data from several urban and suburban locations throughout the United States of America and calculated a mean concentration of iodomethane in ambient air of 0.02 ppbv during 1972-85. The global measurements of iodomethane show that it is uniformly distributed over the ocean, with a range of 0.5–1.0 ppbv (Rasmussen et al., 1982). Brodzinsky and Singh (1982) have also compiled 561 ambient air data from several urban and rural locations throughout the United States of America for a period of 1983 to 1985. They reported a maximum of 0.08 ppbv with the median concentration of 0.004 ppbv of iodomethane.

(F) Ozone Depletion Potential

Methyl halide compounds (methyl bromide, methyl chloride, and methyl iodide) are very reactive agents when released into the atmosphere (Redeker et al., 2000). Ozone depletion can be caused by an increase in the concentration of halogen radicals (chlorine, bromine and iodine) in the stratosphere. Photodissociation of CH_3I produces iodine radicals that can reach the stratosphere in two ways: CH_3I can drift into the stratosphere before photo- dissociation releases iodine radicals (Pathway A), or dissociation can occur in the troposphere and a fraction of the iodine radicals can be transported into the stratosphere (Pathway B). Because CH_3I is short-lived in the atmosphere, pathway B is likely to be quite important because the iodine radicals will generally be released in the troposphere, rather than the stratosphere, where the ozone layer is located. If iodomethane and/or iodine transported to the stratosphere, all iodine became available for free radical chemistry and it has been calculated that at the altitudes between 15-20 km the efficiency of iodine for ozone destruction is several folds greater than that of chlorine (Soloman et al., 1994; up to 800 times more effective according to recent modelling studies of Wuebbles et al., 2001.)

To simulate the distribution of I_x, the Atmospheric and Environmental Research's 2-dimensional chemical transport model (AER 2-D CTM) was used (MRID 45593712). The calculation assumes the soluble I_x species released (HI, HOI and IONO2) are subject to removal by the processes of washout or dry deposition in the troposphere, while the bulk of I_x in the stratosphere is in the form of I and IO. Calculated standard washout rate, which has an average first-order removal lifetime of 2 to 10 days, and a deposition velocity of 1 cm/sec. The empirical ODP can be defined by the following equation:

$ODP^{emp} = ODP(trop) + ODP(stratA) + ODP(stratB)$

where

$ODP(trop)$ = ODP of in the troposphere due to I_x accumulation,

ODP (*stratA*) = ODP in the stratosphere due to I_x that are delivered by pathway A,

ODP(*stratB*) = ODP in the stratosphere due to I_x that are delivered by pathway B.

All of these pathways need to be considered in deriving the Ozone Depletion Potential for a short-lived gas like iodomethane.

Reliable ODP values for CH_3I are difficult to obtain directly from model calculations for two reasons: 1) the model calculations show that the accumulation of I_x in the troposphere leads to ozone depletion in the troposphere, but the model is not capable of resolving variabilities in the troposphere on a regional scale, making the predicted results unreliable. 2) The models have not been tested to determine if they can accurately predict transport of short-lived source gases and their degradation products from the troposphere to the stratosphere. Nonetheless, the recent studies of Wuebbles and colleagues at the University of Illinois (personal communication, 2002) give an ODP for CH_3I of 0.029 assuming evenly distributed emissions with latitude. The ODP would be greater in the tropics and smaller than this at high latitudes. Only in the case of emissions in the tropics would there be an ODP approaching 0.1. Zhang et al. (1998) reported that the estimated ODP of iodomethane is less than 0.016, which is well below the 0.65 ODP for methyl bromide and the Class 1 listed ozone depleter compounds of the U.S. Environmental Protection Agency. Under Title VI, Section 602 of the Clean Air Act, the US Environmental Protection Agency classified any substance with an ODP 0.2 or greater as Class 1 ozone depleting substance. However, this analysis would not have considered all of the pathways, and certainly did not consider that the ODP would be a function of location of the emissions for such a short-lived gas (Wuebbles et al., 2001).

(G) Global Warming Potential

Radiative forcing is the ability of a gas to absorb infrared radiation (within the atmospheric spectral window of 750cm-1 and 1300 cm-1), changing the balance of radiation absorbed or emitted by the atmosphere. A gas that strongly absorbs radiation in the atmospheric window, reduces the direct transmission of radiation emitted by the earth to space, enhancing the greenhouse effect (MRID 45593712).

One measure of the effectiveness of a gas to act as a greenhouse gas is the change in radiative forcing at the tropopause. Using the IR absorption cross-section derived from the absorption data from EPA's Office of Air Quality Planning and Standards (http://www.epa.gov/ttn/emc/ftir/refcas.html), the AER 1-D RC model to calculate the radiative forcing for CH_3I, assuming that the concentration of CH_3I in the stratosphere was zero. If the mixing ratio of CH_3I decreased to 5% of its surface value at the tropopause, the radiative forcing was 2.8 x 10^{-3} Watt m^{-2} $pbbv^{-1}$ burden. If the CH_3I was well-mixed, the radiative forcing was 5.0 x 10^{-3} Watt m^{-2} per pbbv burden. For comparison purposes the radiative forcing for methane (CH_4) and CH_3Br were 5.0 x 10^{-4} Watt m^{-2} $pbbv^{-1}$ and 1.0 x 10^{-2} Watt m^{-2} $pbbv^{-1}$, respectively.

The radiative forcing results and a lifetime of 5.2 days were used to calculate the global warming potential (GWP) with different integration time horizons. In the case in which the mixing ratio of CH_3I decreases to 5% of its surface value at the tropopause (radiative forcing is 2.8 x 10^{-3} Watt m^{-2} $pbbv^{-1}$), the GWP(20), GWP(100) and GWP(500) were calculated to be 0.06, 0.02, and 0.01, respectively. If CH_3I is assumed to be well-mixed (radiative forcing is 5.0 x 10^{-3} Watt m^{-2} $pbbv^{-1}$), the GWP(20), GWP(100) and GWP(500) were calculated to be 0.11, 0.03, and 0.01, respectively. The calculated values indicate that iodomethane may have negligible impact on greenhouse warming.

V. WATER RESOURCE ASSESSMENT

Rapid volatilization of iodomethane from water and soil surfaces is expected to be an important process due to a Henry's Law constant of 5.26E-03atm-m^3/mole. Field studies suggest that volatility yielded 54 to 80 percent of applied iodomethane even before tarpaulin was removed. Field dissipation data suggest that applied iodomethane was more confined to the soil horizons adjacent to the 30-cm depth of iodomethane placement. In California, fumigated field was chiseled to aerate the site and enhanced the volatilization of residual iodomethane. Residual concentration of ≤ 0.011 mg a.i./kg on the day 8 and no iodomethane after 15 days were detected below one meter depth. In Florida, low residual concentrations of iodomethane of ≤ 0.269 mg a.i./kg at day 7 and ≤0.034 mg a.i./kg at day 28 were detected below one meter depth of the soil profile, which were higher than the California site. No residual iodomethane was detected at the end of the study period (90 days) in either site. Since this compound is very soluble in water and has low adsorption into soil, it can potentially leach into shallow ground water and leaky aquifers, especially when removal or slicing of the ground tarpaulin coincides with, or is followed soon by, a rain event. Tier II PRZM/EXAMS for surface water and Tier I SCIGROW for ground water were used to estimate iodomethane concentrations (Table 4 and 5). Note that these concentrations are in nanograms per liter (ng/L), or parts per trillion. Based on environmental fate, the residual contents in soils, and Tier I and II models estimated concentrations, EFED does not expect iodomethane to adversely impact ground water or surface water.

(B) Estimated Environment Concentration for Drinking Water Assessment

The estimated drinking water concentrations (EDWCs) in surface waters derived from Tier II PRZM/EXAMS simulation employing Florida pepper index reservoir scenario and in ground waters calculated from SCIGROW are noted in Table 4. Since iodomethane is a volatile compound, additional input parameters like DAIR (vapor phase diffusion coefficient) and ENPY (enthalpy of vaporization) were activated during the PRZM-EXAMS simulation. The assessments were based on maximum application rate of iodomethane for pepper in

Florida. A complete discussion of these models and the associated input parameters and output for each scenario is presented in Appendix A. These values generally represent upper-bound estimates of the concentrations that might be found in surface water and groundwater due to the use of iodomethane on pepper in Florida.

Table 4. Tier I and II Estimated Drinking Water Concentrations of iodomethane

Chemical	Surface Water EDWCs (ng/L)		Groundwater EDWCs (ng/L)
	Acute	Cancer Chronic	Acute and Chronic
Iodomethane	1965	6.7	60

ng/L = ppt

(B) Estimated Environment Concentration for Ecological Risk Assessment

Estimated Environmental Concentrations (EECs) used to determine acute and chronic risks to aquatic organisms were estimated using tomato and pepper scenarios and Tier II PRZM/EXAMS models. Since iodomethane is a volatile compound, additional input parameters like DAIR (vapor phase diffusion coefficient) and ENPY (enthalpy of vaporization) were activated during the PRZM-EXAMS simulation.

Table 5. Tier II Estimated Environmental Concentrations of iodomethane

Crop	Application Rate lb a.i./A	Number of Applications	Acute Conc ng/L	96 Hour Conc ng/L	21 Day Conc ng/L	60 Day Conc ng/L
California Tomato	242	1	383	140	29	10
Florida Pepper	242	1	942	224	43	15

ng/L = ppt

A complete discussion of these models and the associated input parameters and output for each scenario is presented in Appendix A. The maximum application rate (242 a.i. lbs/A)for these crops and the relevant environmental fate parameters for iodomethane were used in PRZM/EXAMS screening models. The EECs to be used for ecological risk assessments are presented in Table 5.

Monitoring Data (Surface water and Groundwater)

Iodomethane has been detected in the surface water bodies. Naturally occurring iodomethane in sea water have been interpreted in terms of photochemical production mechanisms or in-situ synthesizing by marine organisms. Recent studies (Schall et al., 1994 and Nightingale et al., 1995) have demonstrated that marine organisms like phytoplankton and macro algae are capable of producing iodomethane in marine environments. Moore and Zafirou (1994) reported that the mean concentration of 1.6 ng/l in the seawater samples from the eastern Pacific Ocean. At present time, iodomethane is not included in the Pesticides in Ground Water Database, National Water Quality Assessment Program (NAWQA) of United States Geological Survey (www.water.wr.usgs.gov), and it is also not included in the National Pesticide Survey.

VI. ECOLOGICAL HAZARD DATA

(A) Summary

Available data indicate iodomethane is moderately toxic to birds (bobwhite quail) on both an acute oral and inhalation basis. It is highly toxic on an acute basis to freshwater invertebrates (*Daphnia magna*) and moderately toxic on an acute basis to fish (rainbow trout).

Below is a presentation of the EPA's current iodomethane ecological toxicity data base.

(B) Toxicity to Terrestrial Animals

i. Birds, Acute and Subacute

An acute oral toxicity study using the technical grade of the active ingredient (TGAI) is required to establish the toxicity of iodomethane to birds. The avian oral LD_{50} is an acute, single-dose laboratory study designed to estimate the quantity of toxicant required to cause 50% mortality in a test population of birds. The preferred test species is either the mallard duck, a waterfowl, or northern bobwhite quail, an upland gamebird. The TGAI is administered by oral intubation to adult birds, and the results are expressed as LD_{50} milligrams (mg) active ingredient (a.i.) per kilogram (kg). Toxicity category descriptions are the following:

If the LD_{50} is *less than 10 mg a.i./kg*, then the test substance is *very highly toxic*.
If the LD_{50} is *10-to-50 mg a.i./kg*, then the test substance is *highly toxic*.
If the LD_{50} is *51-to-500 mg a.i./kg*, then the test substance is *moderately toxic.*
If the LD_{50} is *501-to-2,000 mg a.i./kg*, then the test substance is *slightly toxic.*
If the LD_{50} is *greater than 2,000 mg a.i./kg*, then the test substance is *practically nontoxic*.

Table 7: Avian Acute Oral Toxicity - Technical

Species	% ai	LD_{50} (mg a.i./kg)	Toxicity Category	MRID/Accession (AC) No. Author/Year	Study Classification[1]
northern bobwhite quail *(Colinus virginianus*)	99.7	57	moderately toxic	45593716/Gallagher & Beavers/2001	Core

[1] Core means study satisfies guideline. Supplemental means study is scientifically sound, but does not satisfy guideline.

The guideline (71-1a) is fulfilled (MRIDs 45593716).

Two dietary studies using the TGAI are usually required to establish the toxicity of pesticides to birds. However, given the volatility of iodomethane and its proposed use as a soil fumigant under ground that is immediately tarped, these studies are not needed at present for risk assessment.

Because of the volatility of iodomethane, the registrant has submitted an avian inhalation study. There is no established guideline (Subdivision E, 1982) for this test type.

Table 8: Avian Acute Inhalation - Technical

Species	% ai	LC_{50} (ppm in air)	Toxicity Category	MRID/Accession (AC) No. Author/Year	Study Classification[1]
Northern Bobwhite Quail *(Colinus virginianus)*	99.7	395 (4-hr. exposure)	moderately toxic	45593717/Kiplinger/2002	Supplemental

[1] Core means study satisfies guideline. Supplemental means study is scientifically sound, but does not satisfy guideline.

While this study is considered scientifically sound, it is not a guideline study and thus is classified as Supplemental. Iodomethane is considered moderately toxic on an acute basis.

(C) Toxicity to Freshwater Aquatic Animals
i. Freshwater Fish, Acute

Two freshwater fish toxicity studies using the TGAI are usually required to establish the toxicity of pesticides to fish. The preferred test species are rainbow trout (a coldwater fish) and bluegill sunfish (a warmwater fish). Results of one of these tests are listed below. The toxicity category descriptions for freshwater and estuarine/marine fish and aquatic invertebrates, are defined below in parts per million (ppm).

If the LC_{50} is *less than 0.1 ppm a.i.*, then the test substance is *very highly toxic*.
If the LC_{50} is *0.1-to-1.0 ppm a.i.*, then the test substance is *highly toxic*.
If the LC_{50} is *greater than 1 and up through 10 ppm a.i.*, then the test substance is *moderately toxic.*
If the LC_{50} is *greater than 10 and up through 100 ppm a.i.*, then the test substance is *slightly toxic.*
If the LC_{50} is *greater than 100 ppm a.i.*, then the test substance is *practically nontoxic.*

Table 9: Freshwater Fish Acute Toxicity - Iodomethane Technical

Species/ Flow-through or Static	% ai	LC_{50} (ppm) / (C.I.)	Toxicity Category	MRID/Accession (AC) No. Author/Year	Study Classification

Table 9: Freshwater Fish Acute Toxicity - Iodomethane Technical

Species/ Flow-through or Static	% ai	LC_{50} (ppm) / (C.I.)	Toxicity Category	MRID/Accession (AC) No. Author/Year	Study Classification
Rainbow Trout (Oncorhynchus sp.)/static-renewal	99.7	1.33/ (1.12-1.56)	Moderately toxic	45593714/Drottar, et. al./2002	Core

With an LC_{50} of 1.33 ppm, iodomethane is categorized as moderately toxic to rainbow trout on an acute basis. The guideline for rainbow trout (72-1c) is fulfilled (45593714). A bluegill sunfish study is required for risk assessment and labeling.

(ii) Freshwater Invertebrates, Acute

A freshwater aquatic invertebrate toxicity test using the TGAI is required to establish the toxicity of iodomethane to aquatic invertebrates. The preferred test organism is *Daphnia magna*, but early instar amphipods, stoneflies, mayflies, or midges may also be used. Results of this test are tabulated below.

Table 10: Freshwater Invertebrate Acute Toxicity - Iodomethane Technical

Species/Static or Flow-through	% ai	EC_{50} (ppm)/(C.I.)	Toxicity Category	MRID/Author/Year	Study Classification[1]
Daphnid *(Daphnia magna)*/static-renewal	99.7	0.57/ (0.43-0.79) NOEC= 0.073	highly toxic	45593713/Drottar et. al./2001	Core

[1] Core (study satisfies guideline). Supplemental (study is scientifically sound, but does not satisfy guideline).

With an EC_{50} of 0.57 ppm, iodomethane is categorized as highly toxic to freshwater aquatic invertebrates on an acute basis. The guideline (72-2a) is fulfilled (MRID 45089914).

VII. AQUATIC EXPOSURE AND RISK ASSESSMENT

The highest acute aquatic exposure estimate (EEC) for iodomethane presented in Table 5 above is 0.942 ppb, for Florida peppers. Comparing this value to the acute toxicity value for the most sensitive test species (*D. magna*, 570 ppb) produces a maximum risk quotient of 0.0017. This is well below the lowest acute aquatic Level-of-Concern (LOC) of 0.05 (endangered species). Thus, EFED does not consider iodomethane to pose an acute risk to aquatic invertebrates or fish. EFED also believes that the Henry's Law Constant of 5.23E-03atm-m^3/mole for iodomethane suggest that chronic exposures to the aquatic invertebrates and fish are not likely to occur. Although methanol and formaldehyde are major transformation products of aqueous photolysis of iodomethane, such transformation is expected to be minimal due to the primary route of dissipation to the air.

VIII. TERRESTRIAL EXPOSURE AND RISK ASSESSMENT

It appears that the principal risk to terrestrial wildlife will be from the inhalation of air residues near the treated sites. Estimated air concentrations are the highest on the application day, despite the mandatory tarping of treated sites. Estimated concentrations range up to 0.987 ppm at 30 cm above the tarp and up to 0.453 ppm at 80 cm above the tarp, based on submitted data. These values are estimated flux values based on cumulative charcoal tube residues collected following an application of 242 lb ai/A (measured rate). This measured application rate is just above the proposed maximum label rate of 235 lb ai/A.

The avian acute inhalation LC_{50}, based on a four-hour exposure of bobwhite quail, is 395 ppm. Given that this is over 400X the peak estimated residues above, it does not appear that there is a substantial risk of acute lethality to birds, even if they do fly above or land on the tarp on the day of application. The lowest test concentration was 344 ppm, where sublethal effects were seen, including ataxia, gasping, and rales. Given that a No Effect Level was not obtained, it is not possible to say with certainty that there would be no sublethal effects at the expected maximum exposure levels above. However, given that the lowest test level was approximately 350X greater than the expected maximum residues, it is quite possible that there would be no sublethal effects as well. Iodomethane is also a short-lived chemical (direct photolysis, ≤11.5 days) in the atmosphere, therefore, there is low potential for chronic risk to birds and mammals.

Because of dispersion and photolysis of iodomethane, organisms off the treated sites (e.g., birds, wild mammals) would likely be exposed to substantially lower residues and risk than those immediately above the tarp on the day of application. Mammals appear to be less acutely sensitive than birds to iodomethane. The reported mammal acute inhalation LC50 is 4.0 mg/L (8/12/02 HED Memorandum; Appendix B), which is equivalent to 689 ppm.

The HED recommended endpoint for human health risk assessment for all exposure time intervals is the inhalation maternal NOAEL in a developmental toxicity study with female New Zealand White rabbits, which is 10 ppm (8/12/02 HED Memorandum). This study included exposure of six hours/day on gestation days 6 through 28 (ibid.). It appears that 10 ppm is above acute wild mammal exposure and thus substantial risk is not expected.

It is not expected that there would be any major use by wildlife of the soil under the tarp. However, some wildlife (e.g., amphibians) may possibly seek dark, warm, moist areas that such an area might provide. Any such use could possibly result in a lethal exposure, due to fumigant concentrations.

Guideline plant studies (seed germination/seedling emergence, vegetative vigor, aquatic plant growth) are required to complete a risk assessment to plants. It is assumed, given the label reference to potential "...damage caused by drift to other plants or crops", that iodomethane could be hazardous to plants off-site. However, based in part on a prior draft biological opinion from USFWS for tarped uses of methyl bromide, the Field and External Affairs Division (FEAD) does not presently have a concern for the proposed tarped uses of iodomethane and endangered species, including endangered plants (3/20/03 note from A. Stavola, FEAD).

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APPENDIX A

Modeling Inputs/Outputs for Ecological and Drinking Water Risk Assessment

The maximum application rate and relevant environmental fate parameters for iodomethane were used in the two screening models PRZM/EXAMS and SCIGROW for iodomethane concentrations in surface water and groundwater, respectively. The outputs of the two screening models represent estimates of the concentrations that might be found in surface water and groundwater due to the use of iodomethane on selected crops.

Estimation of surface water exposure concentrations for Ecological Risk Assessment

The maximum application rate and relevant environmental fate parameters for iodomethane were used in the PRZM/EXAMS Tier II model for EECs in the surface water. The output of the screening model represent an upper-bound estimate of the concentrations of iodomethane that might be found in surface water due to use of iodomethane on selected crops. The weather, agricultural practices, and iodomethane applications were simulated over 30 years so that the ten year excedence probability at the site could be estimated. The EECs generated in this analysis were estimated using PRZM 3.12 (Pesticide Root Zone Model) for simulating runoff and erosion from the agricultural field and EXAMS 2.98.5 (Exposure Analysis Modeling System) for estimating environmental fate and transport in surface water. Table A-1 summarizes the input values used in the selected crops and models run for PRZM/EXAMS.

Estimation of Surface Water Exposure Concentrations for Drinking Water Assessment

PRZM/EXAMS modeling using the Index Reservoir (IR) and the Percent Crop Area (PCA) adjustment was used to estimate concentrations in surface water used as a source of drinking water. The index reservoir represents a watershed that is more vulnerable than most used as drinking water sources. It was developed from a real watershed in western Illinois. The index reservoir is used as a standard watershed that is combined with local soils, weather, and cropping practices to represent a vulnerable watershed for each crop that could support a drinking water supply. If a community derives its drinking water from a large river, the estimated exposure would likely be higher than the actual exposure. Conversely, a community that derives its drinking water from smaller bodies of water with minimal outflow would likely get higher drinking water exposure than estimated using the index reservoir. Areas with a more humid climate that use a similar reservoir and golf coarse turf management practices would likely get more pesticides in their drinking water than predicted levels.

A single steady flow has been used to represent the flow through the reservoir. Discharge from the reservoir also removes chemical from it so this assumption will underestimate removal from the reservoir during wet periods and overestimates removal during dry periods. This assumption can both underestimate or overestimate the concentration in the reservoir depending upon the annual precipitation pattern at the site. The index reservoir scenario uses the characteristic of a single soil to represent all soils in the basin. Soils can vary substantially across even small areas, thus, this variation is not reflected in these simulations.

The index reservoir scenario does not consider tile drainage. Areas that are prone to substantial runoff are often tile drained. This may underestimate exposure, particularly on a chronic basis (the watershed on which the IR is based had no documented tile drainage). Additionally, EXAMS is unable to easily model spring and fall turnover which would result in complete mixing of a chemical through the water column during these events. Because of this inability, Shipman City Lake has been simulated without stratification. There is data to suggest that Shipman City Lake does stratify in the deepest parts of the lake at least in some years. This may result in both an over and underestimation of the concentration in drinking water depending upon the time of the year and the depth the drinking water intake is drawing from. A full description of the Index Reservoir is provided in the "*Guidance for Use of the Index Reservoir in Drinking Water Exposure Assessment*" from EFED upon request.

Development a Percent Crop Area (PCA), watershed-based adjustment factor for the percent of land in production for a specific crop, for Cherry/stone fruits has not been performed. The SAP recommended against the use of the PCA for 'minor' crops because it believed that the scale of the watershed size used to develop the PCA (8-digit HUC) was too large to capture each drinking water watershed and the resulting PCAs would likely be highly inaccurate and not conservative (for the purpose of PCA development, cherry/stone fruits can be considered a minor crop). In the absence of a crop specific PCA, a default PCA of 0.87 is currently being used.

The maximum application rate and relevant environmental fate parameters for cyprodinil were used in the PRZM/EXAMS Tier II model for EDWCs in the surface water. The output of the screening model represent an upper-bound estimate of the concentrations of cyprodinil that might be found in surface water due to use of cyprodinil on Florida cabbage (Table A-6). The weather, agricultural practices, and cyprodinil applications were simulated over 30 years so that the ten year excedence probability at the site could be estimated. The EDWCs generated in this analysis were estimated using PRZM 3.12 (Pesticide Root Zone Model) for simulating runoff and erosion from the agricultural field and EXAMS 2.98.5 (Exposure Analysis Modeling System) for estimating environmental fate and transport in surface water. Table A-1 summarizes the input values used in the Florida cabbage and models run for PRZM/EXAMS.

Table A-1. PRZM/EXAMS Input Parameters for Iodomethane

Parameters	Values & Units	Sources
Molecular Weight	141.94 g $Mole^{-1}$	Registrant Data
Vapor Pressure 25°C	405.9 mm Hg @ 25°C	Product Chemistry
Water Solubility @ pH 7.0 and 25°C	1420 mg/L @ 25°C	MRID 45593705
Henry's law constant	5.26E-03atm-m^3/mole	www.toxnet.nlm.nil.gov
Air Diffusion Coefficient	5345 cm2/day	Calculated
Enthalpy of vaporization	20 kcal/mol	PRZM Standard
Hydrolysis Half-Life (pH 7)	94 days	MRID 45593705
Aerobic Soil Metabolism $t_{½}$,	0.25days[†]	MRID 45593707[‡]
Anaerobic- Aquatic metabolism: for entire	5.0 days[†]	MRID 45593708[‡]

Table A-1. PRZM/EXAMS Input Parameters for Iodomethane

Parameters	Values & Units	Sources
sediment/water system		
Direct Aqueous Photolysis	13.0 days	MRID 45593706
Soil Water Partition Coefficient	34.8 L Kg^{-1} (Mean K_{oc})	MRID 45593709

CROP MANAGEMENT

Florida Tomato

Modeling scenario	Riviera Sand - MLRA 156A; Florida	
Culture type (Weed and moisture control)	Plastic Tarp	
Pesticide application frequency and rate	1 × 242.0 (lb a.i./A)	Registrant Provided
Application Date	37694	Registrant Provided
Application Method	Ground Injection	Registrant Provided
Spray Efficiency	100%	EFED
Spray Drift	None	Standard assumption

† = Input half-life was calculated from reported half-lives according to Guidance for selecting input parameters in modeling for environmental fate and transport of pesticides. Version II. December 4, 2001.

Estimation of Ground Water Concentrations for Drinking Water Assessment

SCIGROW is a regression-based model that provides a groundwater screening exposure value to be used in determining the potential risk to human health from drinking water contaminated with the pesticide. Since the SCI-GROW concentrations are likely to be approached in only very small percentage of drinking water sources (i.e. highly vulnerable aquifers), it is not appropriate to use SCI- GROW for national or regional exposure estimates.

SCIGROW estimates likely groundwater concentrations if the pesticide is used at the maximum allowable rate in areas where groundwater is exceptionally vulnerable to contamination. In most cases, a large majority of the use area will have groundwater that is less vulnerable to contamination than the areas used to derive the SCIGROW estimate.

Table 2. SCIGROW Input Parameters for Iodomethane

Parameters	Values & Units	Sources
Aerobic Soil Metabolism $t_{1/2}$,†	0.25days	MRID 45593707‡
Soil Water Partition Coefficient	34.8 L Kg^{-1} (Mean K_{oc})	MRID 45593709
Pesticide application rate/Year	1 × 242.0 (lb a.i./A)	Registrant Provided

Attachments

(1) PRZM/EXAMS Model Output for Ecological Risk Assessment

Florida Pepper
Chemical: Iodomethane
PRZM environment: FLpeppersC.txt
EXAMS environment: pond298.exv
Metfile: w12844.dvf
Application Method: Ground Injection
Application Rate: 1X 242 a.i. lbs/A

Water segment concentrations (ppb)

Year	Peak	96 hr	21 Day	60 Day	90 Day	Yearly
1961	0.00035	0.00007	0.00001	0	0	7.99E-07
1962	1.19E-10	2.92E-11	5.65E-12	1.98E-12	1.32E-12	3.25E-13
1963	6.73E-14	1.71E-14	3.38E-15	1.18E-15	7.89E-16	1.95E-16
1964	0.003237	0.000686	0.000131	4.59E-05	3.06E-05	7.53E-06
1965	6.35E-25	5.88E-25	3.33E-25	1.40E-25	9.39E-26	2.32E-26
1966	3.95E-19	1.32E-19	2.67E-20	9.33E-21	6.22E-21	1.53E-21
1967	3.22E-16	1.02E-16	2.05E-17	7.17E-18	4.78E-18	1.18E-18
1968	0.1735	0.04365	0.008431	0.002951	0.001967	0.000484
1969	0.000863	0.000218	4.21E-05	1.47E-05	9.81E-06	2.42E-06
1970	4.05E-11	9.25E-12	1.77E-12	6.21E-13	4.14E-13	1.02E-13
1971	9.15E-27	2.88E-27	5.94E-28	2.08E-28	1.39E-28	3.44E-29
1972	1.83E-18	5.52E-19	1.11E-19	3.89E-20	2.59E-20	6.38E-21
1973	6.95E-13	1.66E-13	3.25E-14	1.14E-14	7.59E-15	1.87E-15
1974	41.98	8.59	1.642	0.5747	0.3831	0.09447
1975	3.40E-23	2.48E-23	1.19E-23	4.77E-24	3.19E-24	7.87E-25
1976	4.32E-40	3.99E-40	2.34E-40	1.01E-40	6.73E-41	1.68E-41
1977	0	0	0	0	0	0
1978	0	0	0	0	0	0
1979	0	0	0	0	0	0
1980	9.22E-22	2.81E-22	5.64E-23	1.98E-23	1.32E-23	3.24E-24
1981	0.000995	0.000232	4.46E-05	1.56E-05	1.04E-05	2.57E-06
1982	2.38E-12	4.93E-13	9.46E-14	3.31E-14	2.21E-14	5.44E-15
1983	0.9544	0.2293	0.04415	0.01545	0.0103	0.00254
1984	7.08E-09	1.85E-09	3.79E-10	1.33E-10	8.85E-11	2.18E-11
1985	1.62E-06	3.51E-07	6.71E-08	2.35E-08	1.57E-08	3.86E-09
1986	1.843	0.4628	0.08907	0.03118	0.02078	0.005125
1987	0.8319	0.1796	0.0344	0.01204	0.008026	0.001979
1988	1.30E-11	2.91E-12	5.57E-13	1.95E-13	1.30E-13	3.20E-14
1989	1.23E-19	3.69E-20	7.42E-21	2.60E-21	1.73E-21	4.27000e-22
1990	6.44E-20	1.87E-20	3.76E-21	1.32E-21	8.78E-22	2.16E-22

Sorted results

Prob.	Peak	96 hr	21 Day	60 Day	90 Day	Yearly
0.03	41.98	8.59	1.642	0.5747	0.3831	0.09447
0.06	1.843	0.4628	0.08907	0.03118	0.02078	0.005125
0.10	0.9544	0.2293	0.04415	0.01545	0.0103	0.00254
0.13	0.8319	0.1796	0.0344	0.01204	0.008026	0.001979

0.16	0.1735	0.04365	0.008431	0.002951	0.001967	0.000484
0.19	0.003237	0.000686	0.000131	4.59E-05	3.06E-05	7.53E-06
0.23	0.000995	0.000232	4.46E-05	1.56E-05	1.04E-05	2.57E-06
0.26	0.000863	0.000218	4.21E-05	1.47E-05	9.81E-06	2.42E-06
0.29	0.00035	7.26E-05	1.39E-05	4.86E-06	3.24E-06	7.99E-07
0.32	1.62E-06	3.51E-07	6.71E-08	2.35E-08	1.57E-08	3.86E-09
0.35	7.08E-09	1.85E-09	3.79E-10	1.33E-10	8.85E-11	2.18E-11
0.39	1.19E-10	2.92E-11	5.65E-12	1.98E-12	1.32E-12	3.25E-13
0.42	4.05E-11	9.25E-12	1.77E-12	6.21E-13	4.14E-13	1.02E-13
0.45	1.30E-11	2.91E-12	5.57E-13	1.95E-13	1.30E-13	3.20E-14
0.48	2.38E-12	4.93E-13	9.46E-14	3.31E-14	2.21E-14	5.44E-15
0.52	6.95E-13	1.66E-13	3.25E-14	1.14E-14	7.59E-15	1.87E-15
0.55	6.73E-14	1.71E-14	3.38E-15	1.18E-15	7.89E-16	1.95E-16
0.58	3.22E-16	1.02E-16	2.05E-17	7.17E-18	4.78E-18	1.18E-18
0.61	1.83E-18	5.52E-19	1.11E-19	3.89E-20	2.59E-20	6.38E-21
0.65	3.95E-19	1.32E-19	2.67E-20	9.33E-21	6.22E-21	1.53E-21
0.68	1.23E-19	3.69E-20	7.42E-21	2.60E-21	1.73E-21	4.27E-22
0.71	6.44E-20	1.87E-20	3.76E-21	1.32E-21	8.78E-22	2.16E-22
0.74	9.22E-22	2.81E-22	5.64E-23	1.98E-23	1.32E-23	3.24E-24
0.77	3.40E-23	2.48E-23	1.19E-23	4.77E-24	3.19E-24	7.87E-25
0.81	6.35E-25	5.88E-25	3.33E-25	1.40E-25	9.39E-26	2.32E-26
0.84	9.15E-27	2.88E-27	5.94E-28	2.08E-28	1.39E-28	3.44E-29
0.87	4.32E-40	3.99E-40	2.34E-40	1.01E-40	6.73E-41	1.68E-41
0.90	0	0	0	0	0	0
0.94	0	0	0	0	0	0
0.97	0	0	0	0	0	0
0.1	0.94215	0.22433	0.043175	0.015109	0.010073	0.002484
		Average of yearly averages:				0.003487

Inputs generaged by pe4.pl - 8-January-2003

California Tomato
Chemical: Iodomethane
PRZM environment: CAtomatoC.txt
EXAMS environment: pond298.exv
Metfile: w93193.dvf
Application Method: Ground Injection
Application Rate: 1X242 a.i. lbs/A

Water segment concentrations (ppb)

Year	Peak	96 hr	21 Day	60 Day	90 Day	Yearly
1961	3.90E-17	2.60E-17	7.50E-18	2.64E-18	1.76E-18	4.34E-19
1962	1.67E-16	7.63E-17	1.81E-17	6.33E-18	4.22E-18	1.04E-18
1963	0.7684	0.2743	0.05596	0.01959	0.01306	0.00322
1964	1.58E-18	1.34E-18	8.73E-19	4.45E-19	3.05E-19	7.53E-20
1965	3.23E-31	3.04E-31	2.12E-31	1.08E-31	7.36E-32	1.82E-32
1966	0	0	0	0	0	0
1967	0	0	0	0	0	0
1968	0.0522	0.01742	0.003497	0.001224	0.000816	0.000201
1969	4.51E-20	3.91E-20	2.58E-20	1.31E-20	9.00E-21	2.23E-21
1970	1.24E-32	1.04E-32	6.54E-33	3.19E-33	2.17E-33	5.37E-34
1971	0	0	0	0	0	0

1972	0	0	0	0	0	0
1973	7.80E-14	3.23E-14	7.24E-15	2.53E-15	1.69E-15	4.17E-16
1974	2.48E-29	2.18E-29	1.44E-29	7.21E-30	4.92E-30	1.22000e-30
1975	1.40E-42	1.40E-42	1.40E-42	0	0	0
1976	0	0	0	0	0	0
1977	0.2422	0.08694	0.01776	0.006216	0.004144	0.001022
1978	2.34E-16	9.26E-17	2.06E-17	7.21E-18	4.81E-18	1.19E-18
1979	4.46E-19	1.87E-19	4.06E-20	1.42E-20	9.47E-21	2.34E-21
1980	5.18E-35	4.33E-35	2.71E-35	1.31E-35	8.92E-36	2.20E-36
1981	0.000149	5.11E-05	1.03E-05	3.61E-06	2.41E-06	5.93E-07
1982	0.3982	0.1466	0.03016	0.01056	0.007037	0.001735
1983	0.01037	0.004259	0.000883	0.000309	0.000206	5.08E-05
1984	3.47E-21	3.35E-21	2.35E-21	1.17E-21	7.97E-22	1.96E-22
1985	2.79E-13	1.11E-13	2.51E-14	8.78E-15	5.85E-15	1.44E-15
1986	27.92	8.3	1.632	0.5714	0.3809	0.09392
1987	1.64E-11	5.50E-12	1.11E-12	3.88E-13	2.59E-13	6.38E-14
1988	2.05E-27	1.80E-27	1.19E-27	5.92E-28	4.03E-28	9.92E-29
1989	4.25E-23	1.73E-23	3.82E-24	1.34E-24	8.91E-25	2.20E-25
1990	9.05E-39	7.81E-39	5.14E-39	2.60E-39	1.77E-39	4.37E-40

Sorted results

Prob.	Peak	96 hr	21 Day	60 Day	90 Day	Yearly
0.03	27.92	8.3	1.632	0.5714	0.3809	0.09392
0.06	0.7684	0.2743	0.05596	0.01959	0.01306	0.00322
0.1	0.3982	0.1466	0.03016	0.01056	0.007037	0.001735
0.13	0.2422	0.08694	0.01776	0.006216	0.004144	0.001022
0.16	0.0522	0.01742	0.003497	0.001224	0.000816	0.000201
0.19	0.01037	0.004259	0.000883	0.000309	0.000206	5.08E-05
0.23	0.000149	5.11E-05	1.03E-05	3.61E-06	2.41E-06	5.93E-07
0.26	1.64E-11	5.50E-12	1.11E-12	3.88E-13	2.59E-13	6.38E-14
0.29	2.79E-13	1.11E-13	2.51E-14	8.78E-15	5.85E-15	1.44E-15
0.32	7.80E-14	3.23E-14	7.24E-15	2.53E-15	1.69E-15	4.17E-16
0.35	2.34E-16	9.26E-17	2.06E-17	7.21E-18	4.81E-18	1.19E-18
0.39	1.67E-16	7.63E-17	1.81E-17	6.33E-18	4.22E-18	1.04E-18
0.42	3.90E-17	2.60E-17	7.50E-18	2.64E-18	1.76E-18	4.34E-19
0.45	1.58E-18	1.34E-18	8.73E-19	4.45E-19	3.05E-19	7.53E-20
0.48	4.46E-19	1.87E-19	4.06E-20	1.42E-20	9.47E-21	2.34E-21
0.52	4.51E-20	3.91E-20	2.58E-20	1.31E-20	9.00E-21	2.23E-21
0.55	3.47E-21	3.35E-21	2.35E-21	1.17E-21	7.97E-22	1.96E-22
0.58	4.25E-23	1.73E-23	3.82E-24	1.34E-24	8.91E-25	2.20E-25
0.61	2.05E-27	1.80E-27	1.19E-27	5.92E-28	4.03E-28	9.92E-29
0.65	2.48E-29	2.18E-29	1.44E-29	7.21E-30	4.92E-30	1.22E-30
0.68	3.23E-31	3.04E-31	2.12E-31	1.08E-31	7.36E-32	1.82E-32
0.71	1.24E-32	1.04E-32	6.54E-33	3.19E-33	2.17E-33	5.37E-34
0.74	5.18E-35	4.33E-35	2.71E-35	1.31E-35	8.92E-36	2.20E-36
0.77	9.05E-39	7.81E-39	5.14E-39	2.60E-39	1.77E-39	4.37E-40
0.81	1.40E-42	1.40E-42	1.40E-42	0	0	0
0.84	0	0	0	0	0	0
0.87	0	0	0	0	0	0
0.90	0	0	0	0	0	0
0.94	0	0	0	0	0	0

0.97	0	0	0	0	0	0
0.10	0.3826	0.140634	0.02892	0.010126	0.006748	0.001664
				Average of yearly averages:		0.003338

(II) PRZM/EXAMS Model Output for Drinking Water Assessment (Surface Water)

Florida Pepper
Chemical: Iodomethane
PRZM environment: FLpeppersC.txt
EXAMS environment: ir298.exv
Metfile: w12844.dvf
Application method: Ground Injection
Application Rate: 242 a.i. lbs/A

Water segment concentrations (ppb)

Year	Peak	96 hr	21 Day	60 Day	90 Day	Yearly
1961	0.000839	0.000162	3.09E-05	1.08E-05	7.21E-06	1.78E-06
1962	2.86E-10	6.51E-11	1.26E-11	4.39E-12	2.93E-12	7.22E-13
1963	1.61E-13	3.75E-14	7.35E-15	2.57E-15	1.72E-15	4.23E-16
1964	0.00776	0.001522	0.000291	0.000102	6.78E-05	1.67E-05
1965	9.26E-25	8.53E-25	4.86E-25	2.07E-25	1.39E-25	3.42E-26
1966	9.47E-19	2.98E-19	5.96E-20	2.09E-20	1.39E-20	3.43E-21
1967	7.71E-16	2.31E-16	4.60E-17	1.61E-17	1.07E-17	2.64E-18
1968	0.4159	0.09522	0.01828	0.006398	0.004265	0.001049
1969	0.00207	0.000476	9.15E-05	3.20E-05	2.13E-05	5.26E-06
1970	9.71E-11	2.04E-11	3.91E-12	1.37E-12	9.11E-13	2.25E-13
1971	2.20E-26	6.51E-27	1.32E-27	4.63E-28	3.09E-28	7.63E-29
1972	4.38E-18	1.25E-18	2.49E-19	8.72E-20	5.81E-20	1.43E-20
1973	1.67E-12	3.13E-13	5.99E-14	2.10E-14	1.40E-14	3.45E-15
1974	101	19.11	3.646	1.276	0.8508	0.2098
1975	3.75E-22	2.77E-22	1.35E-22	5.47E-23	3.66E-23	9.03E-24
1976	1.07E-38	9.76E-39	5.75E-39	2.51E-39	1.68E-39	4.13E-40
1977	0	0	0	0	0	0
1978	0	0	0	0	0	0
1979	0	0	0	0	0	0
1980	2.21E-21	6.35E-22	1.26E-22	4.41E-23	2.94E-23	7.22E-24
1981	0.002387	0.000511	9.79E-05	3.43E-05	2.28E-05	5.63E-06
1982	5.70E-12	1.10E-12	2.11E-13	7.37E-14	4.91E-14	1.21E-14
1983	2.288	0.5027	0.09632	0.03371	0.02248	0.005542
1984	1.69E-08	4.13E-09	8.30E-10	2.91E-10	1.94E-10	4.76E-11
1985	3.87E-06	7.70E-07	1.47E-07	5.15E-08	3.43E-08	8.47E-09
1986	4.418	1.014	0.1943	0.06799	0.04533	0.01118
1987	1.995	0.4087	0.07813	0.02735	0.01823	0.004495
1988	3.11E-11	6.51E-12	1.25E-12	4.37E-13	2.91E-13	7.16E-14
1989	2.96E-19	8.38E-20	1.67E-20	5.84E-21	3.89E-21	9.60E-22
1990	1.54E-19	4.32E-20	8.60E-21	3.01E-21	2.01E-21	4.95E-22

Sorted results

Prob.	Peak	96 hr	21 Day	60 Day	90 Day	Yearly
0.03	101	19.11	3.646	1.276	0.8508	0.2098
0.06	4.418	1.014	0.1943	0.06799	0.04533	0.01118
0.10	2.288	0.5027	0.09632	0.03371	0.02248	0.005542

0.13	1.995	0.4087	0.07813	0.02735	0.01823	0.004495
0.16	0.4159	0.09522	0.01828	0.006398	0.004265	0.001049
0.19	0.00776	0.001522	0.000291	0.000102	6.78E-05	1.67E-05
0.23	0.002387	0.000511	9.79E-05	3.43E-05	2.28E-05	5.63E-06
0.26	0.00207	0.000476	9.15E-05	3.20E-05	2.13E-05	5.26E-06
0.29	0.000839	0.000162	3.09E-05	1.08E-05	7.21E-06	1.78E-06
0.32	3.87E-06	7.70E-07	1.47E-07	5.15E-08	3.43E-08	8.47E-09
0.35	1.69E-08	4.13E-09	8.30E-10	2.91E-10	1.94E-10	4.76E-11
0.39	2.86E-10	6.51E-11	1.26E-11	4.39E-12	2.93E-12	7.22E-13
0.42	9.71E-11	2.04E-11	3.91E-12	1.37E-12	9.11E-13	2.25E-13
0.45	3.11E-11	6.51E-12	1.25E-12	4.37E-13	2.91E-13	7.16E-14
0.48	5.70E-12	1.10E-12	2.11E-13	7.37E-14	4.91E-14	1.21E-14
0.52	1.67E-12	3.13E-13	5.99E-14	2.10E-14	1.40E-14	3.45E-15
0.55	1.61E-13	3.75E-14	7.35E-15	2.57E-15	1.72E-15	4.23E-16
0.58	7.71E-16	2.31E-16	4.60E-17	1.61E-17	1.07E-17	2.64E-18
0.61	4.38E-18	1.25E-18	2.49E-19	8.72E-20	5.81E-20	1.43E-20
0.65	9.47E-19	2.98E-19	5.96E-20	2.09E-20	1.39E-20	3.43E-21
0.68	2.96E-19	8.38E-20	1.67E-20	5.84E-21	3.89E-21	9.60E-22
0.71	1.54E-19	4.32E-20	8.60E-21	3.01E-21	2.01E-21	4.95E-22
0.74	2.21E-21	6.35E-22	1.35E-22	5.47E-23	3.66E-23	9.03E-24
0.77	3.75E-22	2.77E-22	1.26E-22	4.41E-23	2.94E-23	7.22E-24
0.81	9.26E-25	8.53E-25	4.86E-25	2.07E-25	1.39E-25	3.42E-26
0.84	2.20E-26	6.51E-27	1.32E-27	4.63E-28	3.09E-28	7.63E-29
0.87	1.07E-38	9.76E-39	5.75E-39	2.51E-39	1.68E-39	4.13E-40
0.90	0	0	0	0	0	0
0.94	0	0	0	0	0	0
0.97	0	0	0	0	0	0
0.10	2.2587	0.4933	0.094501	0.033074	0.022055	0.005437
		Average of yearly averages:				0.0077

Inputs generaged by pe4.pl - 8-January-2003

Estimated Drinking Water Concentration (EDWC)

Acute EEC = (1/10 peak value)(percent crop area)
= (2259 ng/L)(0.87) =1965 ng/L

Non-cancer Chronic EEC =(1/10 yearly value)(percent area area)
(5.4 ng/L)(0.87) =4.70 ng/L

Cancer chronic EEC = (Mean of annual value)(percent crop area)
(7.7 ng/L)(0.87) = 6.7 ng/L

(III) SCIGROW Model Output for Drinking Water Assessment (Ground Water)

```
RUN No.   1 FOR Iodomethane        INPUT VALUES
--------------------------------------------------------------------
 APPL (#/AC)  APPL.  URATE    SOIL    SOIL  AEROBIC
 RATE         NO. (#/AC/YR)  KOC   METABOLISM (DAYS)
--------------------------------------------------------------------
 242.000     1    242.000      34.8        .25

GROUND-WATER SCREENING CONCENTRATIONS IN PPB
--------------------------------------------------------
              .062492
--------------------------------------------------------
A=     .042  B=    39.800  C=    -1.380  D=     1.600  RILP=    -2.208
F=    -3.588  G=      .000  URATE=   242.000  GWSC=        .062492
```

APPENDIX B

TXR NO. 0051037

DATE: August 12, 2002

<u>MEMORANDUM</u>

SUBJECT: **Iodomethane** - Report of the Hazard Identification Assessment Review Committee.

FROM: John E. Whalan, Toxicologist
Registration Action Branch 2
Health Effects Division (7509C)

THROUGH: Jess Rowland, Co-Chair
and
Elizabeth Doyle, Co-Chair
Hazard Identification Assessment Review Committee
Health Effects Division (7509C)

TO: Mary L. Waller, PM 12
Registration Division (7505C)

PC Code: **000011**

On July 30, 2002, the Health Effects Division (HED) Hazard Identification Assessment Review Committee (HIARC) reviewed the recommendations of the toxicology reviewer for iodomethane with regard to the toxicological endpoint selection for use as appropriate in occupational and bystander risk assessments. The potential for increased susceptibility of infants and children from exposure to iodomethane was not considered because there will be no residue on food. The conclusions drawn at this meeting are presented in this report.

Committee Members in Attendance

Members present were:

William Burnam
Pamela Hurley
Elizabeth Mendez
John Liccione
Jess Rowland
Jonathan Chen
Brenda Tarplee

Member(s) in absentia:

Elizabeth Doyle
David Nixon
Ayaad Assaad
Steve Knizner
Sue Makris

Data evaluation prepared by:

John E. Whalan, RAB2

Also in attendance were:

Alan Levy, RAB2

Data Evaluation / Report Presentation ______________________

John E. Whalan
Toxicologist

INTRODUCTION

On July 30, 2002, the Health Effects Division (HED) Hazard Identification Assessment Review Committee (HIARC) reviewed the recommendations of the toxicology reviewer for iodomethane with regard to the toxicological endpoint selection for use as appropriate in occupational and bystander risk assessments. The potential for increased susceptibility of infants and children from exposure to iodomethane was not considered because there will be no residue on food.

Iodomethane is a methyl bromide alternative that does not affect stratospheric ozone. Arvesta Corporation (formerly TomenAgro) has requested the registration of iodomethane as a pre-plant soil fumigant for use on strawberries and tomatoes to control soil-borne diseases, nematodes, and weed seeds. It can be injected into fields with the same equipment used for methyl bromide. Iodomethane has a higher boiling point than methyl bromide (42.5°C v 3.6°C), and one-fourth the vapor pressure (398 mmHg v 1600 mmHg at 20°C).

Names:	Iodomethane, methyl iodide
Description:	Deep yellow, translucent liquid
CAS #:	74-88-4
Molecular Weight:	141.95 g/Mol
Melting Point:	-66.5°C
Boiling Point:	42.5°C
Vapor Pressure:	398 mmHg
Specific Gravity:	2.28 at 20°C (2001 © ACGIH)
TLV-TWA	2 ppm (12 mg/m^3)

Structure:

$$I\text{-}CH_3$$

The toxic mode of action on target pests, laboratory animals, and humans is not known. Because there are no food residues in crops grown in treated soil, this is not a food use. Although there are no residential uses, homes and businesses adjacent to a treated field can be exposed to off-gassed iodomethane. Proposed iodomethane:chloropicrin formulations include 98:2, 50:50, and 25:75. Formulating with chloropicrin allows much less iodomethane to be used.

I. FQPA HAZARD CONSIDERATIONS

There are no FQPA considerations because iodomethane is a non-food use and there are no residential uses.

II. HAZARD IDENTIFICATION

1. Acute Reference Dose (aRfD) - Because there are no food uses, an acute RfD was not established.

2. Chronic Reference Dose (cRfD) - Because there are no food uses, a chronic RfD was not established.

3. Incidental Oral Exposure: Short-Term (1-30 days) - There are no residential uses and no potential for exposure to infants or children, so an oral dose and toxicity endpoint were not selected.

4. Incidental Oral Exposure: Intermediate-Term (1 - 6 Months) - There are no residential uses and no potential for exposure to infants or children, so an oral dose and toxicity endpoint were not selected.

5. Dermal Absorption - Not applicable.

6. Dermal Exposure: Short-Term (1- 30 days) Exposure - The use pattern will not result in dermal exposure, so a dermal dose and toxicity endpoint were not selected.

7. Dermal Exposure: Intermediate-Term (1 - 6 Months) - The use pattern will not result in dermal exposure, so a dermal dose and toxicity endpoint were not selected.

8. Dermal Exposure Long-Term (> 6 Months) - The use pattern will not result in dermal exposure, so a dermal dose and toxicity endpoint were not selected.

9. Inhalation Exposure: All-Time Intervals and All Populations

Study Selected: Inhalation Developmental Toxicity Study in Rabbits §870.3700

MRID No.: 45593811

Executive Summary: In a developmental toxicity study (MRID 45593811), groups of 24 female New Zealand White rabbits were dynamically exposed to iodomethane vapor (Lot/batch # 007403/02; 99.6% a.i.) in whole-body inhalation chambers at analytical concentrations of 0, 2, 10, or 20 ppm (0, 0.012, 0.058, or 0.12 mg/L/day) six hours per day on gestation days (GDs) 6 through 28. All surviving does were sacrificed on GD 29, and their fetuses were removed by cesarean section and examined.

No mortalities occurred during the study. When compared to concurrent controls, no treatment-related changes were observed in body weights, body weight gains, food consumption, sex ratios, or maternal gross pathology.

At 20 ppm, an increased number of late resorptions/doe were observed (1.6 treated vs. 0.1 controls), which resulted in increased post-implantation loss in these animals (2.0 treated vs. 0.7 controls). In addition, decreased (p<=0.05) gravid uterine weights were noted (decreased 31%). This decrease was attributed to decreased numbers of live fetuses/doe (decreased 41%) and decreased fetal weights (decreased 20%). Increased incidences of hair loss and wet, clear matting around the nose were noted in the 20 ppm animals compared to controls. Although these findings are of equivocal toxicological importance, they are evidence of nasal irritation. The post-implantation loss, decreased number of live fetuses, and decreased fetal weights may have been a consequence of subjecting the does to repeated respiratory irritation.

The maternal LOAEL is 20 ppm (0.12 mg/L/day) based on post-implantation loss due to late resorptions, and a decreased number of live fetuses. The maternal NOAEL is 10 ppm (0.058 mg/L/day).

The developmental toxicity LOAEL is 20 ppm (0.12 mg/L/day) based on decreased fetal weights (↓20%). The developmental toxicity NOAEL is 10 ppm (0.058 mg/L/day).

Dose/Endpoint for Risk Assessment: The maternal NOAEL is 0.058 mg/L/day based on post-implantation loss due to late resorptions, and a decreased number of live fetuses at the LOAEL of 0.12 mg/L/day.

Comments about Study/Endpoint: This endpoint should be used in risk assessments for all durations of human inhalation exposure. The following table demonstrates that the length of the inhalation toxicity study (from 1 to 90 days) has little effect on toxicity. The maternal NOAEL in the rabbit developmental toxicity study is about half that of the other NOAELs, possibly due to an idiosyncratic effect in rabbits.

Study	NOAEL	LOAEL
Acute neurotoxicity - rats	0.16 mg/L	0.54 mg/L
Developmental toxicity - rats	0.12 mg/L/day	0.35 mg/L/day
Developmental toxicity - rabbits	0.058 mg/L/day	0.12 mg/L/day

13-week toxicity - rats	0.12 mg/L/day	0.41 mg/L/day

10. Margin of Exposure

The target Margin of Exposure (MOEs) for **inhalation occupational and bystander** exposure risk assessments is **100**.

11. Recommendation for Aggregate Exposure Risk Assessments

Not applicable because there are no residential uses.

III. CLASSIFICATION OF CARCINOGENIC POTENTIAL

1. Combined Chronic Toxicity/Carcinogenicity Study in Rats - This study is not required because iodomethane is a non-food use.

2. Carcinogenicity Study in Mice - This study is not required because iodomethane is a non-food use.

3. Classification of Carcinogenic Potential - Carcinogenicity is not a concern because iodomethane will not have a food use, and there is no likelihood of long-term human exposure.

IV. MUTAGENICITY

Negative responses were observed in an Ames Assay, an *in vitro* mammalian cell mutation test in Chinese Hamster Ovary Cells, and in an *in vivo* micronucleus assay in mice. The only positive finding was in an *in vitro* chromosomal aberration test in Chinese Hamster Ovary in which there was induction of structural chromosome aberrations (clastogenesis). There was no induction of numerical aberrations in CHO cells, however. The HIARC concluded that there is no concern for mutagenicity resulting from exposure to iodomethane.

V. HAZARD CHARACTERIZATION

Toxicity Data Base Overview: The toxicity data base for iodomethane is limited because it has no food uses. The inhalation route has been well characterized, however, because this is the major route of worker exposure. The studies that have been submitted and reviewed include an battery of acute studies, an inhalation acute neurotoxicity study in rats, a 13-week inhalation toxicity study in rats, inhalation developmental toxicity studies in rats and rabbits, four mutagenicity studies, and a comparative oral v inhalation metabolism study in rats (not required by HED). These are all Acceptable/Guideline studies.

There is a potential for accidental dermal exposure to iodomethane in workers due to a spill. Dermal exposure is expected to cause a rapid and persistent dermal response, but no systemic toxicity. No dermal toxicity studies were requested because the dermal dose cannot be quantified (iodomethane evaporates quickly from the skin), and there is no expectation of systemic toxicity.

An inhalation 2-generation reproductive toxicity study was submitted, but was not reviewed due to regulatory time constraints and the fact that it is not needed for non-food-use registration. No chronic or carcinogenicity studies are required because iodomethane has no food uses, and there is no likelihood of long-term human exposure.

Acute Toxicity: The Toxicity Categories for technical iodomethane are I for eye irritation, II for acute oral toxicity (in rats and mice) and skin irritation, III for acute dermal toxicity, and IV for acute inhalation toxicity. It is corrosive to the eyes with adverse signs persisting at 21 days, and is a severe skin irritant with rapid onset and effects persisting as much as 28 days.

Pharmacokinetics and Cumulative Toxicity: A comparison of NOAELs and LOAELs demonstrates that the length of an inhalation toxicity study (from 1 to 90 days) has little effect on toxicity. This illustrates that there is minimal cumulation of iodomethane in the body. Although the maternal NOAEL in the rabbit developmental toxicity study is about half that of the other NOAELs, this is likely due to an idiosyncratic effect in rabbits (hypersensitivity to an irritant).

Study	NOAEL	LOAEL
Acute neurotoxicity - rats	0.16 mg/L	0.54 mg/L
Developmental toxicity - rats	0.12 mg/L/day	0.35 mg/L/day
Developmental toxicity - rabbits	0.058 mg/L/day	0.12 mg/L/day
13-week toxicity - rats	0.12 mg/L/day	0.41 mg/L/day

A comparative oral v inhalation metabolism study (MRID 45641401) was performed in Sprague-Dawley rats using [^{14}C] CH_3I. Maximum blood concentrations were achieved within 4 hours (oral) and 0-2 hours (inhalation), and were proportional to dose/concentration. Initial $t_{½}$ was 5.1-7.2 hours, and terminal $t_{½}$ was 116-136 hours.

Recovered radioactivity was primarily as CO_2 (39.40-60.81% dose) and in the urine (26.50-33.40% dose) in all treated groups, while feces accounted for <2% dose. Radioactivity remained in the carcasses (11.92-14.39% dose) of all treated animals 168 hours following treatment in the main test. Elimination $t_{½}$ were 17.8-22.3 hours for urine, 29.7-38.0 hours for feces, and 5.8-6.8 hours for CO_2 in all treatment groups.

At 0-1 hour post-treatment in orally treated rats and 233 ppm inhalation exposed rats, relatively high levels of radioactivity were observed in the liver and GI tract. Radioactivity was relatively high in the kidney, lung, and nasal turbinates of the 25 ppm inhalation exposed rats and in the kidney, thyroid, and lung of the 233 ppm inhalation exposed rats. At 168 hours post-dose, radioactivity had declined in all tissues and was highest in the kidney, liver, and thyroid. Tissue concentrations increased (not proportionally) with dose. The major metabolites were expired CO_2, and N-(methylthioacetyl) glycine and S-methyl glutathione which were excreted in the urine. Minor metabolites were methylthioacetic acid, methyl mercapturic acid, and S-methyl cysteine.

Subchronic Toxicity: In a subchronic inhalation toxicity study (MRID 45593810), rats were dynamically exposed to iodomethane vapor for 6 hours/day, 5 days/week for 13 weeks at analytical concentrations of 0, 5, 21, or 70 ppm (0, 0.029, 0.12, or 0.41 mg/L/day). There were no effects on mortality, ophthalmology, urinalysis, hematology, organ weights, or gross pathology. The NOAEL is 21 ppm (0.12 mg/L/day), and the LOAEL is 70 ppm (0.41 mg/L/day) based on initial decreases in body weights, body weight gains, and food consumption (males); and nasal degeneration. Respiratory irritation was observed at the interim (4 weeks) and terminal sacrifices. Microscopic findings indicated minimal to mild degeneration/regeneration of the nasal tissues characterized by subacute inflammation, respiratory epithelial metaplasia, degeneration, goblet cell hypertrophy, squamous cell hyperplasia, and minimal alveolar macrophages (females only).

Developmental Toxicity: Female rats were dynamically exposed to iodomethane vapor in whole-body inhalation chambers at analytical concentrations of 0, 5, 20, or 60 ppm (0, 0.03, 0.12, or 0.35 mg/L/day) six hours per day on gestation days (GDs) 6 through 19 (MRID 45593812). No treatment-related changes were observed in clinical signs, the number of live and dead fetuses, resorptions, sex ratios, post-implantation losses, or maternal gross pathology. The maternal NOAEL is 20 ppm (0.12 mg/L/day), and the maternal LOAEL is 60 ppm (0.35 mg/L/day) based on decreased body weight gain (↓19%; ↓5-6% absolute body weight). Because no treatment-related developmental findings were noted at any concentration tested, the developmental NOAEL is 60 ppm (0.35 mg/L/day).

Female New Zealand White rabbits were dynamically exposed to iodomethane vapor in whole-body inhalation chambers at analytical concentrations of 0, 2, 10, or 20 ppm (0, 0.012, 0.058, or 0.12 mg/L/day) six hours per day on gestation days (GDs) 6 through 28 (MRID 45593811). No treatment-related changes were observed in body weights, body weight gains, food consumption, sex ratios, or maternal gross pathology. The maternal NOAEL is 10 ppm (0.058 mg/L/day), and the maternal LOAEL is 20 ppm (0.12 mg/L/day) based on post-implantation loss (2.0 treated v 0.7 controls) due to late resorptions (1.6/treated doe v 0.1/control doe), and a decreased number of live fetuses (↓41%). The post-implantation loss, decreased number of live fetuses, and decreased fetal weights may have been a consequence of subjecting the does to repeated respiratory irritation. The developmental NOAEL is 10 ppm (0.058 mg/L/day), and the developmental LOAEL is 20 ppm (0.12 mg/L/day) based on decreased fetal weights (↓20%).

Chronic Toxicity/Carcinogenicity and Mutagenicity: No chronic or carcinogenicity studies are required or have been submitted. Negative responses were observed in an Ames Assay (MRID 45593813), an *in vitro* mammalian cell mutation test in Chinese Hamster Ovary Cells (MRID 45593815), and in an *in vivo* micronucleus assay in mice (MRID 45593816). The only positive finding was in an *in vitro* chromosomal aberration test in Chinese Hamster Ovary (MRID 45593814) in which there was induction of structural chromosome aberrations (clastogenesis), but no induction of numerical aberrations in CHO cells. The HIARC concluded that there is not a concern for mutagenicity resulting from exposure to iodomethane.

Neurotoxicity: In an acute neurotoxicity study (MRID 45593817), rats were dynamically exposed to iodomethane vapor in a single, six-hour, whole body inhalation exposure at analytical concentrations of 0, 27, 93, or 401 ppm (0, 0.16, 0.54, or 2.3 mg/L). The time of peak effect was estimated to be three hours post-exposure. The NOAEL is 27 ppm (0.16 mg/L). The LOAEL is 93 ppm (0.54 mg/L) based on FOB findings (clonic convulsions and decreased body temperature), and decreased motor activity (↓75-78% in males, 81-84% in females).

Endocrinopathy: None of the animal studies provide any evidence that iodomethane disrupts endocrine receptors.

VI. DATA GAPS / REQUIREMENTS

There are no data gaps.

VII. ACUTE TOXICITY

Acute Toxicity of Iodomethane

Guideline No.	Study Type	MRID #(s)	Results	Toxicity Category
870.1100	Acute Oral - rat	45593803	LD_{50} = 79.8 mg/kg _ LD_{50} = 131.9 mg/kg _	II
870.1100	Acute Oral - mouse	45593804	LD_{50} = 155 mg/kg _ LD_{50} = 214 mg/kg _	II
870.1200	Acute Dermal	45593805	LD_{50} >2000 mg/kg	III
870.1300	Acute Inhalation	45593806	LC_{50} = 4.0 mg/L	IV
870.2400	Primary Eye Irritation	45593807	Corrosive	I
870.2500	Primary Skin Irritation	45593808	Severe irritant	II
870.2600	Dermal Sensitization	45593809	Negative	–

VIII. SUMMARY OF TOXICOLOGY ENDPOINT SELECTION

Summary of Toxicology Endpoint Selection for Iodomethane

Exposure Scenario	**Concentration (mg/L/day) UF /MOE**	**Hazard Based Special FQPA Safety Factor**	**Endpoint for Risk Assessment**
Non-Dietary Risk Assessments			
Inhalation All Time Intervals	Inhalation Maternal NOAEL= 0.058	–	Inhalation Developmental Toxicity-Rabbits Maternal LOAEL = 0.12 mg/L/day based on post-implantation loss due to late resorptions, and a decreased number of live fetuses.
Occupational and bystander	Target MOE = 100	Not applicable	
Cancer	Classification: Not applicable		