Department of Pesticide Regulation

Mary-Ann Warmerdam
Director

Arnold Schwarzenegger
Governor

MEMORANDUM

TO: Joseph P. Frank, DSc., Senior Toxicologist **HSM-04030**
Worker Health & Safety Branch
(916) 324-3517

FROM: Roger C. Cochran, PhD, D.A.B.T., Staff Toxicologist (Specialist)
Worker Health & Safety Branch *(original signed by Roger Cochran)*
(916) 324-3516

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SUBJECT: REVIEW OF OCCUPATIONAL EXPOSURE STUDIES FOR METHYL IODIDE (REGISTRATION TRACKING ID #192892, 192893, 192894)

Overall, the five studies were well conducted. In all instances the workers were double-monitored with air samplers - insuring results in case one pump or filter failed. The field spikes were conducted using air sampling of standards, rather than injecting the material as a liquid directly into the sample tubes. All samples were checked for break-through. In all but one instance, the registrant used the lowest field spike recovery to correct for the measured values. Application rates utilized in the studies were close to, or exceeded, the maximum application rate on the proposed label. Due to an insufficient number of replicates, extrapolation of the data to actual occupational exposures is uncertain.

Shank Injection- I (ID: 192893; Vol. 52875-0064)

A worker/applicator exposure study was conducted near Guadalupe on the central California coast. Monitored meteorological conditions indicated no rainfall during the period of the study, with an average air temperature ranging from 14.8°C to 17.1°C. Each day, from 11:00 AM until 8:00 PM an onshore breeze increased wind velocity from less than 1 m/s to up to a maximum of 20 m/s. The application of methyl iodide was via tarpaulin (standard polyethylene tarp, 1.5 mil) covered /raised-bed/shallow (10 inch depth) shank injection (Baker *et al*., 2004a). This process involves the injection of the pre-plant fumigant into prepared, raised-bed soil through metal shanks, and immediately afterward the fumigated soil is covered with a plastic tarp (extruded via machine) to retard the fumigant escaping the soil. Methyl iodide (99.7% purity) was applied at a measured rate of 178.5 lbs a.i./treated acre to a 2.5 acre plot (the label included with the study report allows a maximum of 235 lbs a.i./treated acre). The test was on bare ground soil, and the test subjects were workers involved in applying methyl iodide (driver, 1st shoveler, 2nd shoveler, 1st tarp monitor, 2nd tarp monitor), or conducting subsequent tasks (hole puncher at 5 days after application; 1st and 2nd planters at 7 days after application). One of the tarp monitors rode the sled, ensuring the plastic rolled out properly, while the second monitor walked along the side, or rode on the rear of the sled, checking the seal of the plastic. One shoveler was positioned at each end of the field to cut the plastic off and seal the end with soil, repair tears with tape, and apply additional soil if areas had been inadequately sealed. Workers wore long sleeved coveralls, or equivalent (long-sleeved shirt, long pants), socks, and

non-rubber boots. Workers were each fitted with 2 air sample tubes (SKC 226-09 with Anasorb® coconut charcoal and a flow rate of 50 mL/min), and duplicate sets of data (with a couple of glitches when one or two air pumps stopped for a few minutes) were obtained from each worker. Two SKC Model 224-44XR personal air sampling pumps, equipped with adjustable low flow holders, were placed on each worker's belt. Tygon tubing attached the pumps to the air sampling tubes, which were clipped to the label, near the worker's breathing zone. Air samples were collected for each worker during the work task. Tractor drivers and shovelers worked 8-8.5 hours. Holes were punched in the polyethylene tarpaulin (5 days after application) using a tractor-mounted device. The hole puncher (driver of the tractor) was monitored for 138 minutes. Two workers planted strawberries (7 days after application), and were monitored for 302 minutes.

Sample tubes were in frozen storage a maximum of five days from collection until extraction. Field spikes, generated by drawing 5 replicate, known air concentrations of methyl iodide at 0.7, 70 or 700 ppb through collection tubes for 1 hour at 50mL/minute, indicated field recoveries of 75%, 79%, and 81%, respectively. All analytical samples collected from workers were corrected for a trapping efficiency of 75%, the lowest field spike recovery in the range of concentrations encountered by workers. Little or no breakthrough of methyl iodide residues into the back-end charcoal of air sample tubes occurred. Residues of methyl iodide were desorbed from the charcoal with ethyl acetate, and quantified by gas chromatography using an electron-capture detector. The limit of quantitation (LOQ) for a flow rate of 50 mL/minute and duration of 2 hours trapping in a collection tube was approximately 0.56 ng/mL. The monitored air concentrations from the breathing zones of the workers involved in this study are given in Table 1.

Table 1. Measured worker body weights, collection air volumes and amounts of methyl iodide associated with work tasks involving pre-plant field fumigation via tarpaulin covered /raised-bed/shallow shank injection.

Work Task	Body Weight (kg)	Average Total Volume[a] (L)	Methyl Iodide[b] (µg)	Air Concentration (µg/L)
Tractor Driver	98	25.8	8.30	0.32
1st Shoveler	47	25.1	5.68	0.23
2nd Shoveler	102	25.6	12.95	0.51
1st Tarp Monitor	94	25.3	3.65	0.15
2nd Tarp Monitor	86	25.4	23.01	0.91
Hole Puncher	86	6.8	0.04	0.01
1st Planter	86	14.9	0.14	0.01
2nd Planter	47	14.9	0.09	0.01

a/ The average volume collected from the two air monitoring devices rigged on the shoulder of each person.
b/ Corrected for 75% trapping efficiency.

Shank Injection- II (ID: 192893; Vol. 52875-0047)

A worker/applicator exposure study was conducted near Oxnard on the southern California coast. Monitored meteorological conditions indicated no rainfall during the period of the study, with an average air temperature ranging from 5°C to 22°C. The onshore breeze was less pronounced, with an average wind velocity varying between 2.4 and 5.7 m/s. The application of methyl iodide was via tarpaulin (polyethylene, 1.5 mil) covered /raised-bed/shallow shank (two shanks, 16 inches apart, approximately 6 inches deep) injection (Baker *et al*., 2003a). Methyl iodide (99.7% purity) was applied at a measured rate of 224.5 lbs a.i./treated acre to a 2.5 acre plot (the label included with the study report allows a maximum of 235 lbs a.i./treated acre). The test was on bare ground soil, and the test subjects were workers involved in applying methyl iodide (driver, 1st shoveler, 2nd shoveler, 1st tarp monitor, 2nd tarp monitor), or conducting subsequent tasks (hole puncher at 5 days after application; 1st and 2nd planters at 7 days after application). The driver operated the tractor while the 1st tarp monitor sat in the shank injector seat. The 2nd tarp monitor walked along in the furrow to check the flow of the test substance and the seal of the plastic tarp. He added soil to the sides of the plastic on occasion. At the end of the pass, the 2nd tarp monitor helped the shoveler seal the end of the bed with soil. The shovelers were positioned at either end of the plot. The shovelers cut the tarp at the end of each pass, using the shovel, and then shoveled soil onto the ends of the tarp. Excess tarp was rolled up by the shovelers and removed from the plot. Workers wore long sleeved coveralls, or equivalent (long-sleeved shirt, long pants) socks, and non-rubber boots.

Unusual Circumstance. The driver conducted two maintenance tasks during application, and these required breach of the rig's closed application system. The 2nd tarp monitor was responsible for observing that the test substance delivery system was functioning correctly, and he walked on the plot alongside the rig during the entire application procedure. In addition, he performed as a shoveler at the ends of the row while the rig raised the shanks from the ground and made a 180° turn. Some of the test substance dripped from the shanks of the rig at the end of each pass during the turn-around procedure in the early portion of the application.

Workers were each fitted with 2 air sample tubes (SKC 226-09 with Anasorb® coconut charcoal and a flow rate of 50 mL/min), and duplicate sets of data were obtained from each worker. Air samples were collected for each worker during the work task. Tractor drivers and shovelers worked 411 minutes. Holes were punched in the polyethylene tarpaulin (5 days after application) using a tractor-mounted device. The hole puncher (driver of the tractor) was monitored for 192 minutes. Two workers planted strawberries (7 days after application), and were monitored for 326 minutes.

Sample tubes were in frozen storage a maximum of five days from collection until extraction. Field spikes, generated by drawing 5 replicate, known air concentrations of methyl iodide at 0.4, 43 or 422 ppb through collection tubes for 1 hour at 50 mL/minute, indicated field recoveries of 53%, 81%, and 79%, respectively. All analytical samples collected from workers were corrected for a trapping efficiency of 53%, as this was the lowest reported recovery and consistent with the selection of a recovery number by the registrant in all other studies. In this

study, the registrant selected a recovery level of 80%, justifying the change in procedure by attributing the lower recovery to a lower concentration than that experienced by the workers. However, the air concentrations of methyl iodide of some of the workers were in this lower range. Consequently, the lowest recovery number, 53%, was used. Little or no breakthrough of methyl iodide residues into the back-end charcoal of air sample tubes occurred. Residues of methyl iodide were desorbed from the charcoal with ethyl acetate, and quantified by gas chromatography using an electron-capture detector. The limit of quantitation (LOQ) for a flow rate of 50 mL/minute and duration of 2 hours trapping in a collection tube was approximately 0.10 ng/mL. The monitored air concentrations from the breathing zones of the workers involved in this study are given in Table 2.

Table 2. Measured worker body weights, collection volumes and amounts of methyl iodide associated with work tasks involving pre-plant field fumigation via tarpaulin covered /raised-bed/shallow shank injection.

Work Task	Body Weight (kg)	Average Total Volume[a] (L)	Methyl Iodide[b] (µg)	Air Concentration (µg/L)
Tractor Driver	77	21.2	177.3	8.36
1st Shoveler	86	21.6	83.1	3.85
2nd Shoveler	95	21.4	141.1	6.59
1st Tarp Monitor	91	21.0	112.8	5.37
2nd Tarp Monitor	60	20.1	182.3	9.07
Hole Puncher	95	9.7	5.8	0.60
1st Planter	86	16.1	0.51	0.03
2nd Planter	85	16.5	0.51	0.03

a/ The average volume collected from the two air monitoring devices rigged on the shoulder of each person.
b/ Corrected for 53% trapping efficiency.

Shank Injection- III (ID:192892, 192893,192894; Vol. 52875-0025)

A worker/applicator exposure study was conducted near Manteca on the central California coast. Monitored meteorological conditions indicated no rainfall during the period of the study, with an average air temperatures ranging from 12°C to 25°C. Wind velocity ranged from 0.9 m/s to up to a maximum of 4 m/s from the northwest. The application of methyl iodide was via broadcast flat fume shallow shank (approximately 11 inches) injection (Baker *et al*., 2001a). Methyl iodide (99.7% purity) was applied at a measured rate of 242 lbs a.i./treated acre to a 2.5 acre plot (the label included with the study report allows a maximum of 235 lbs. a.i./treated acre). The test was on bare ground soil, and the test subjects were workers involved in applying methyl iodide (driver, driver's assistant, 1st shoveler, 2nd shoveler, 1st tarp monitor, 2nd tarp monitor), or conducting subsequent tasks (tarp cutter, tarp remover, and tarp remover driver 5 days after application; and a planter at 7 days after application). The driver and driver's assistant loaded cylinders and tarp rolls onto the application equipment. The driver's assistant

stood on the side platform. The ventilation fan was on during application. At the end of the pass, the driver's assistant stepped off of the platform, cut the tarp, and assisted the shoveler with burying the tarp. Once the tarp was buried, the driver's assistant mounted the platform and continued with the application. The shovelers were positioned at the opposite ends of the plot. Workers wore long-sleeved coveralls, or equivalent (long-sleeved shirt, long pants) socks, and non-rubber boots. Workers were each fitted with 2 air sample tubes (SKC 226-09 with Anasorb® coconut charcoal and a flow rate of 50 mL/min), and duplicate sets of data were obtained from each worker. Air samples were collected for each worker during the work task. The tractor driver and his assistant worked 215 minutes. The shovelers worked 187 minutes. The tarp cutter was monitored for 68 minutes. The tarp remover and the tarp remover driver were monitored for 353 minutes. The planter of strawberries (7 days after application) was monitored for 65 minutes.

Sample tubes were in frozen storage a maximum of five days from collection until extraction. Field spikes, generated by drawing 5 replicate, known air concentrations of methyl iodide at 0.65, 62 or 643 ppb through collection tubes for 1 hour at 50mL/minute, indicated field recoveries of 66%, 66%, and 70%, respectively. In addition, field trapping efficiency levels were examined at 18-22 ppb under day and night conditions. During daytime, approximately 60% of the theoretical level was recovered in these low-level samples. All analytical samples collected from workers were corrected for a trapping efficiency of 66%. Little or no breakthrough of methyl iodide residues into the back-end charcoal of air sample tubes occurred. Residues of methyl iodide were desorbed from the charcoal with ethyl acetate, and quantified by gas chromatography using an electron-capture detector. The limit of quantitation (LOQ) for a flow rate of 50 mL/minute and duration of 2 hours trapping in a collection tube was approximately 0.56 ng/mL. The monitored air concentrations from the breathing zones of the workers involved in this study are given in Table 3.

Table 3. Measured worker body weights, collection volumes and amounts of methyl iodide associated with work tasks involving pre-plant field fumigation via tarpaulin covered /raised-bed/shallow shank injection.

Work Task	Body Weight (kg)	Average Total Volume[a] (L)	Methyl Iodide[b] (µg)	Air Concentration (µg/L)
Tractor Driver	77	10.9	1.08	0.10
Driver's Assistant	91	10.9	6.92	0.63
1st Shoveler	86	9.4	5.30	0.56
2nd Shoveler	80	9.4	1.07	0.11
Tarp Cutter	95	3.4	0.10	0.03
Tarp Remover	75	18.0	1.16	0.06
Tarp Remover Driver	105	18.1	2.14	0.12
Planter	80	3.2	0.11	0.03

a/ The average volume collected from the two air monitoring devices rigged on the shoulder of each person.

b/ Corrected for 66% trapping efficiency.

Drip Irrigation I (ID: 192893; Vol. 52875-0065)

A worker/applicator exposure study was conducted near Camarillo on the southern California coast. Monitored meteorological conditions indicated no rainfall during the period of the study, with an average temperature was 16.7°C. Each day, from 10:00 AM until 6:00 PM an onshore breeze increased wind velocity from less than 1 m/s to up to a maximum of 13 m/s. The application of methyl iodide was via tarpaulin covered /raised-bed/drip irrigation (Baker *et al*., 2004a). This method entails the laying down of plastic irrigation lines in the prepared raised-bed soil. The raised-bed is then covered with plastic tarpaulin. Methyl iodide (99.7% purity) was applied at a measured rate of 175.4 lbs/acre to a 2.5 acre plot (the label included with the study report allows a maximum of 235 lbs a.i./acre; 175 lbs a.i./treated acre). Water flow into the drip lines was monitored using a water meter. The test was on bare ground soil, and the test subjects were workers involved in applying methyl iodide (1st applicator, 2nd applicator), or conducting subsequent tasks (hole puncher at 5 days after application; 1st and 2nd planters at 7 days after application). Workers wore long sleeved coveralls, or equivalent (long sleeved shirt, long pants), socks, and non-rubber boots. Workers were each fitted with 2 air sample tubes (SKC 226-09 with Anasorb® coconut charcoal and a flow rate of 50 mL/min), and duplicate sets of data were obtained from each worker. Air samples were collected for each worker during the work task.

Applicators walked the plot checking for leaks, repairing tarp holes, and laying tarp over areas in which irrigation liquid accumulated in the burrows or repairing drip tape. Applicators were monitored for 276 minutes. Holes were punched in the polyethylene tarpaulin (5 days after application) using a tractor-mounted device. The hole puncher (driver of the tractor) was monitored for 196 minutes. Two workers planted strawberries (7 days after application), and were monitored for 360 minutes.

Sample tubes were in frozen storage a maximum of five days from collection until extraction. Field spikes, generated by drawing 5 replicate, known air concentrations of methyl iodide at 0.7, 70 or 700 ppb through collection tubes for 1 hour at 50mL/minute, indicated field recoveries of 70%, 72%, and 76%, respectively. All analytical samples collected from workers were corrected for a trapping efficiency of 70%. Little or no breakthrough of methyl iodide residues into the back-end charcoal of air sample tubes occurred. Residues of methyl iodide were desorbed from the charcoal with ethyl acetate, and quantified by gas chromatography using an electron-capture detector. The limit of quantitation (LOQ) for a flow rate of 50 mL/minute and duration of 2 hours trapping in a collection tube was approximately 0.17 ng/mL. The monitored air concentrations from the breathing zones of the workers involved in this study are given in Table 4.

(see next page)

Table 4. Measured worker body weights, collection volumes and amounts of methyl iodide associated with work tasks involving pre-plant field fumigation via tarpaulin covered /raised-bed/drip irrigation.

Work Task	Body Weight (kg)	Average Total Volume[a] (L)	Methyl Iodide[b] (µg)	Air Concentration (µg/L)
1st Applicator	91	13.8	4.64	0.34
2nd Applicator	100	14.0	10.58	0.76
Hole Puncher	100	10.0	0.20	0.02
1st Planter	91	17.9	0.06	0.003
2nd Planter	100	18.1	0.05	0.002

a/ The average volume collected from the two air monitoring devices rigged on the shoulder of each person.
b/ Corrected for 70% trapping efficiency.

Drip Irrigation II (ID: 192892, 192893, 192894; Vol. 52875-0055)

A worker/applicator exposure study was conducted near La Selva Beach on the northern California coast. Monitored meteorological conditions indicated no rainfall during the period of the study, with an average temperature ranging from 16.1 to 18.2°C. Wind velocity ranged from 1 to 12 mph. The application of methyl iodide was via tarpaulin covered /raised-bed/drip irrigation (Baker *et al*., 2003b). Methyl iodide (99.7% purity) was applied at a measured rate of 234.3 lbs a.i./acre to a 2.5 acre plot (the label included with the study report allows a maximum of 235 lbs a.i./acre; 175 lbs a.i./treated acre). The test was on bare ground soil, and the test subjects were workers involved in applying methyl iodide (1st applicator, 2nd applicator), or conducting subsequent tasks (hole puncher at 5 days after application; 1st and 2nd planters at 7 days after application). Workers wore long sleeved coveralls, or equivalent (long sleeved shirt, long pants), socks, and non-rubber boots. Workers were each fitted with 2 air sample tubes (SKC 226-09 with Anasorb® coconut charcoal and a flow rate of 50 mL/min), and duplicate sets of data (with a couple of glitches) were obtained from each worker. Air samples were collected for each worker during the work task.

Applicators walked the plot checking for leaks, repairing tarp holes, and laying tarp over areas in which irrigation liquid accumulated in the burrows or repairing drip tape. Applicators were monitored for 377 minutes. Holes were punched in the polyethylene tarpaulin (5 days after application) using a tractor-mounted device. The hole puncher (driver of the tractor) was monitored for 186 minutes. Two workers planted strawberries (7 days after application), and were monitored for 262 minutes.

Sample tubes were in frozen storage a maximum of five days from collection until extraction. Field spikes, generated by drawing 5 replicate, known air concentrations of methyl iodide at 0.7, 71 or 706 ppb through collection tubes for 1 hour at 50mL/minute, indicated field recoveries of 68.5, 75, and 75%, respectively. All analytical samples collected from workers were corrected for a trapping efficiency of 69%. Little or no breakthrough of methyl iodide

residues into the back-end charcoal of air sample tubes occurred. Residues of methyl iodide were desorbed from the charcoal with ethyl acetate, and quantified by gas chromatography using an electron-capture detector. The limit of quantitation (LOQ) for a flow rate of 50 mL/minute and duration of 2 hours trapping in a collection tube was approximately 0.17 ng/mL. The monitored air concentrations from the breathing zones of the workers involved in this study are given in Table 5.

Table 5. Measured worker body weights, collection volumes and amounts of methyl iodide associated with work tasks involving pre-plant field fumigation via tarpaulin covered /raised-bed/drip irrigation.

Work Task	Body Weight (kg)	Average Total Volume[a] (L)	Methyl Iodide[b] (µg)	Air Concentration (µg/L)
1st Applicator	91	19.0	8.6	0.46
2nd Applicator	99	18.9	12.1	0.64
Hole Puncher	99	9.4	0.66	0.07
1st Planter	99	13.5	0.01	0.00
2nd Planter	82	13.2	0.04	0.00

a/ The average volume collected from the two air monitoring devices rigged on the shoulder of each person.
b/ Corrected for 69% trapping efficiency.

References:

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